THE FOUNDRY

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A Model Plant for Making Implement Castings

The Arrangement and Equipment of a Large Gray Iron Foundry Designed Especially for Gray Iron Work

A PIONEER among the industries of the west, the manufacture of agricultural implements is now one of the most highly developed lines of manufacture in the Mississippi valley. For this reason those interested in the subject of modern shop arrangements will find the farm machinery plants of Illinois, Indiana, Wisconsin and neighboring states well worthy of careful investigation and study. The foundries connected with these plants are especially noteworthy because they are called upon to produce a class of work not handled by many other shops. Agricultural castings must be close to size since very little machine work is permitted, and in many cases intricate sections are transferred to the assembling room direct from the cleaning department. In operations of this character, where the cost of producing castings is not overshadowed by subsequent expensive machine tool labor, the foundry occupies a much more prominent position than in many other in-

FIG. 1—MOLDING LARGE WHEELS ON MACHINES IN THE NORTH AISLE OF THE EMERSON-BRANTINGHAM CO.'S FOUNDRY

FIG. 2—SOUTH AISLE OF THE FOUNDRY, SHOWING THE SNAP FLASK FLOORS

dustries. Farm tool makers have, therefore, found it profitable to give their foundry problems special study.

Evidence of this attention to modern facilities for the production of castings is found in the new gray iron foundry operated by the new Emerson-Brantingham Co. at Rockford, Ill. The plant is designed for a capacity of 55 tons of gray iron castings per day, the molding floor being 245 feet long and 124 feet wide. The molding area comprises 30,400 square feet, giving approximately 550 square feet per ton of output daily. These figures must be considered in connection with the fact that the shop is arranged to turn out light agricultural work similar in many ways to the product of the average malleable foundry. The heaviest castings do not weigh over 150 pounds while the lightest pieces tip the scale at less than 8 ounces. The average weight of the castings produced is only 4½ pounds; 75 molders are employed.

In order to obtain a maximum production from the floor area available, elaborate facilities for handling material have been provided, including an extensive system of overhead trolleys for carrying metal, sand and castings. The various floors also are provided with light hand cranes to facilitate the movement of flasks, etc. On account of the light character of the work, no large capacity electric traveling cranes have been provided, although the plant is so arranged that they can be installed at any time when the character

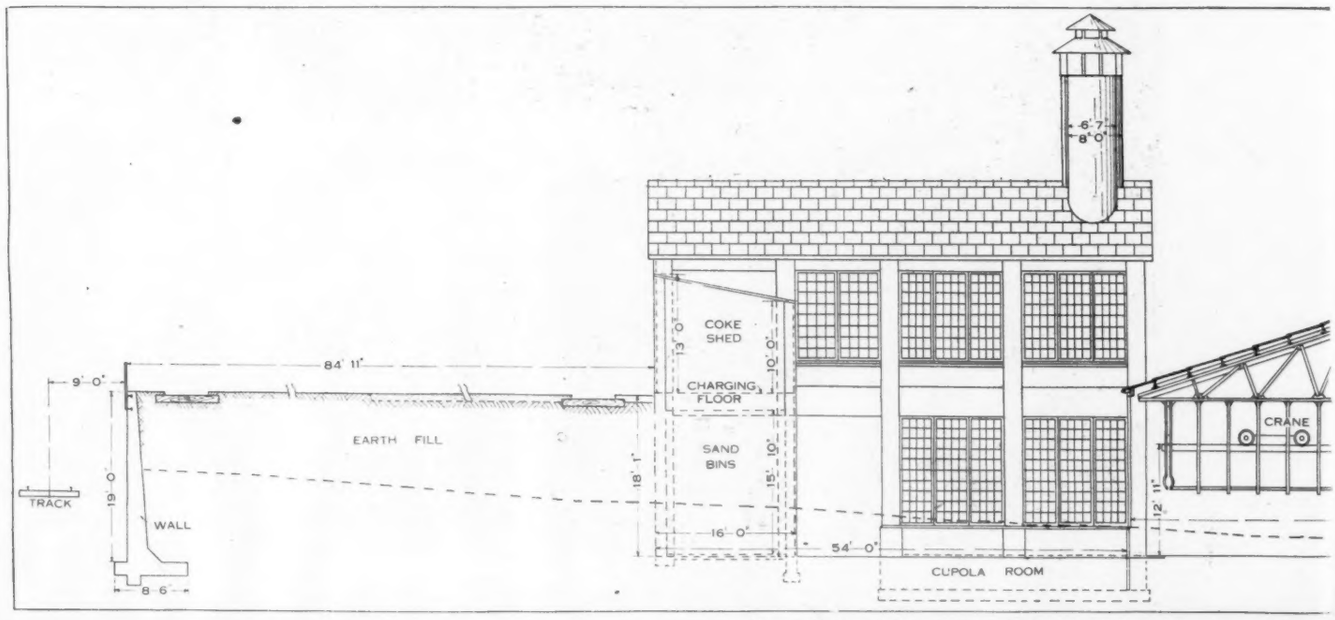


FIG. 3—CROSS-SECTION OF THE NEW FOUNDRY OPERATED

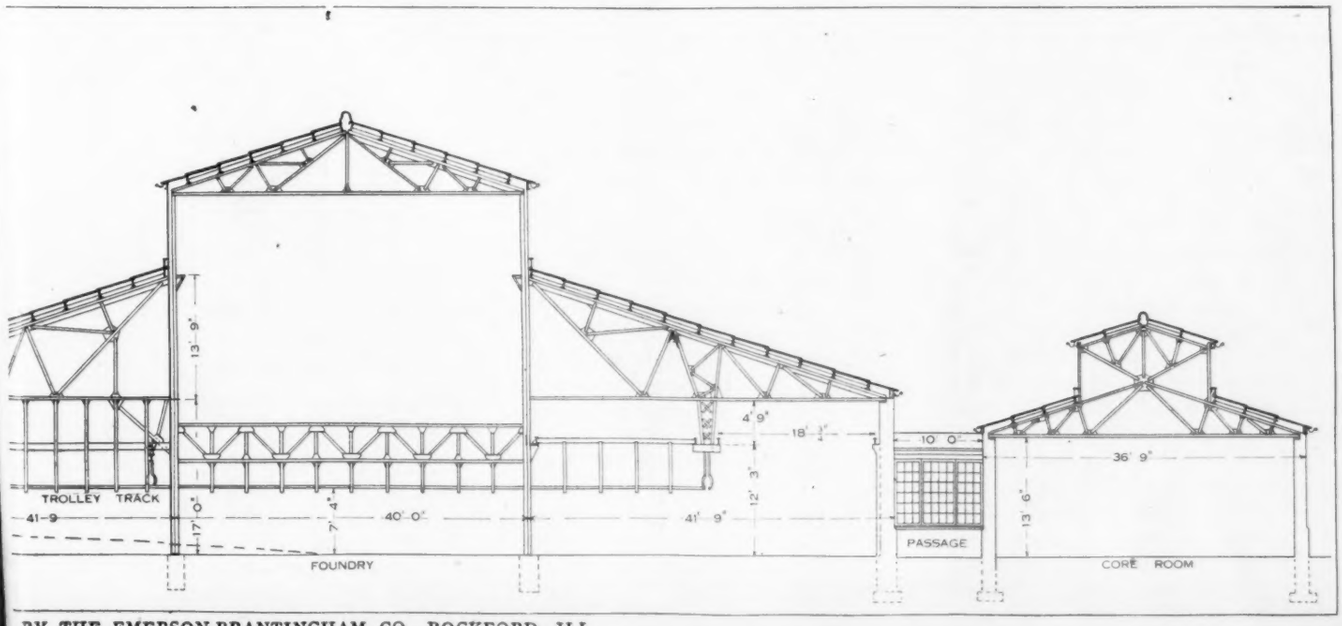
FIG. 4—THE CUPOLAS AND TROLLEY LADLES

of the work might require such equipment.

The three principal departments of the plant, molding, cleaning and core-making, are housed in separate buildings instead of being arranged under one roof. This arrangement was adopted to insure a maximum amount of natural light at all points. A plan of the plant is given in Fig. 5, and Fig. 3 shows a cross-section through the center of the molding floor, core room and charging floor. The foundry is 245 feet long, 124 feet wide, divided into three 40-foot bays or aisles. The building is a brick and steel structure with a cement tile roof. The two cupolas are located in a shed which adjoins the south side of the foundry, as indicated in Fig. 5.

The core department occupies a building, 125 x 34 feet, situated immediately north of and parallel to the molding room, the alley between the two buildings being 10 feet in width. The molding floor and core room are connected by two covered passageways, each 20 feet wide, as indicated in Figs. 3 and 5.

The castings are cleaned on the ground floor of a reinforced concrete building, 202 feet long and 90 feet wide, situated west of the foundry. Two mono-rail trolleys connect the molding floor with the cleaning room. The second floor of the cleaning building is used for pattern and die storage and the third for an experimental department. Between the west wall of the foundry and the east wall of the



BY THE EMERSON-BRANTINGHAM CO., ROCKFORD, ILL.

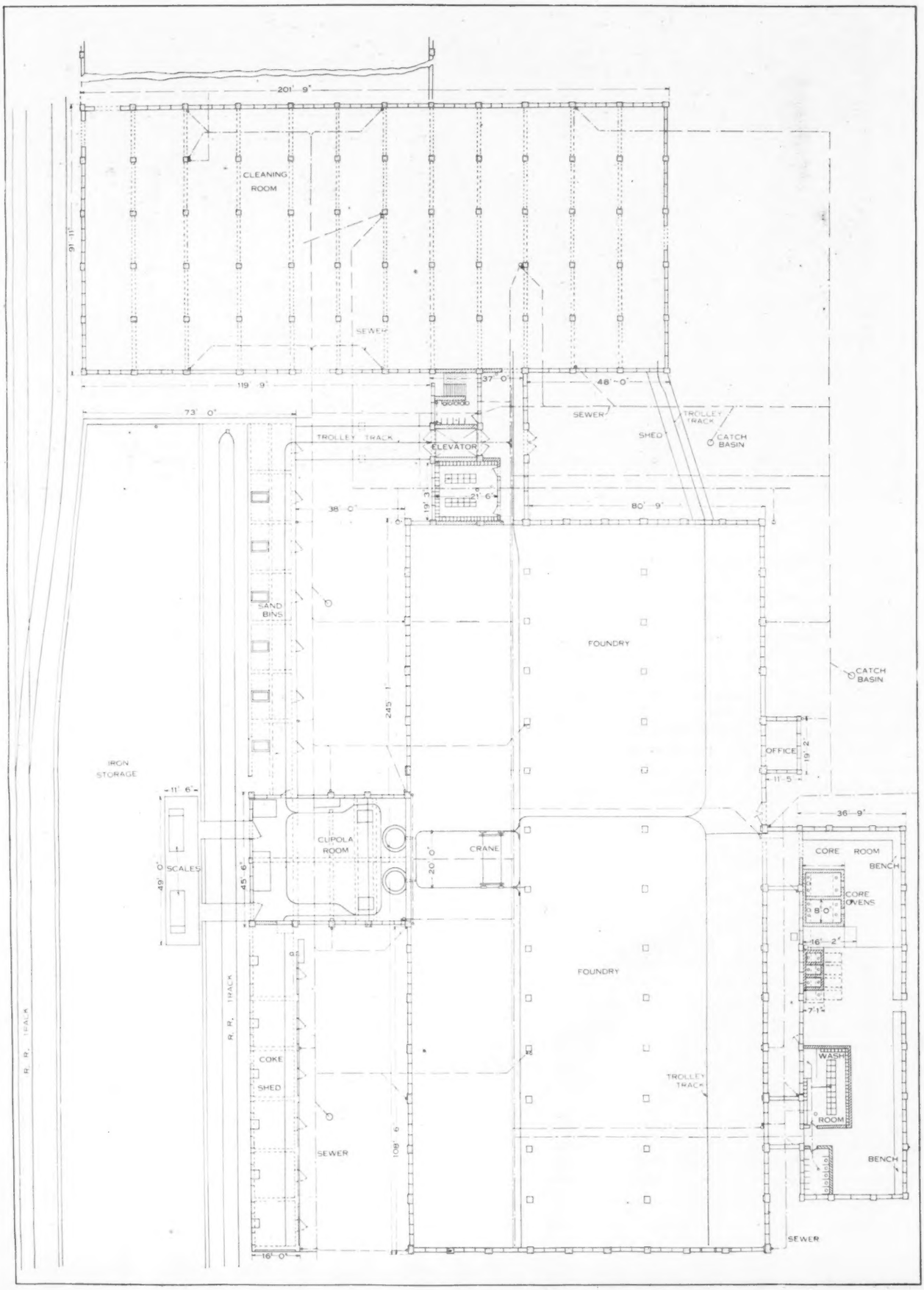


FIG. 5—GROUND PLAN OF THE EMERSON-BRANTINGHAM CO.'S FOUNDRY

cleaning room is a space 50 feet wide, as shown in Fig. 5, utilized for flask storage, stairway, locker and washrooms and for an elevator connecting the three floors of the cleaning building with the charging floor and iron storage yard. Over 70 per cent of the wall space in all of the buildings is glass and in addition, the molding and core rooms are provided with extensive skylights. Artificial light, therefore, will very rarely be required, but for night work the shop is equipped throughout with flaming arcs spaced 50 feet apart in 40-foot rows.

Molding Light Work

The molding practice of the shop may be divided into four classes. The first class, light bench work, is handled in the south bay, Fig. 2. The center aisle, also shown in this illustration, is utilized for a slightly heavier class of floor work, while the north aisle is set aside for the production of heavy castings on molding machines. Occasionally large castings, much heavier than the general run of work in the shop, are required. Such jobs are handled on a special floor, located immediately in front of the cupolas. It is provided with a 5-ton crane and a triplex hoist.

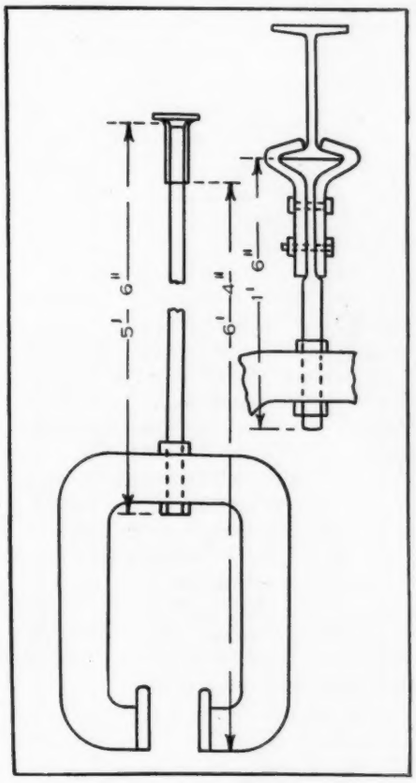


FIG. 6—TROLLEY HANGER AND SUPPORTS

In molding the light work shown in Fig 2, the standard principles of malleable foundry practice are followed to a large extent. Some of the molds are rammed with squeezer machines, but most of the work is done by hand, using snap flasks. The men shown at the left in Fig. 2 are molding spools, using a gated pattern, making two castings in a flask. Each operator makes an average of 130 molds per day at a cost of 3 cents each.

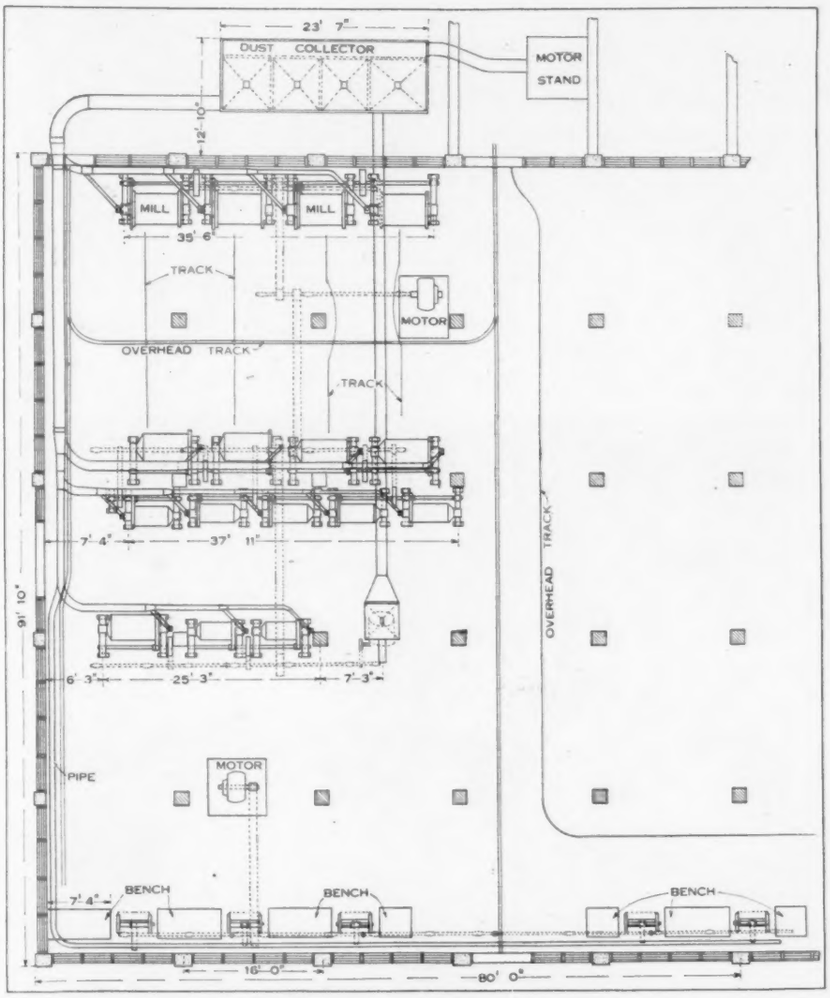
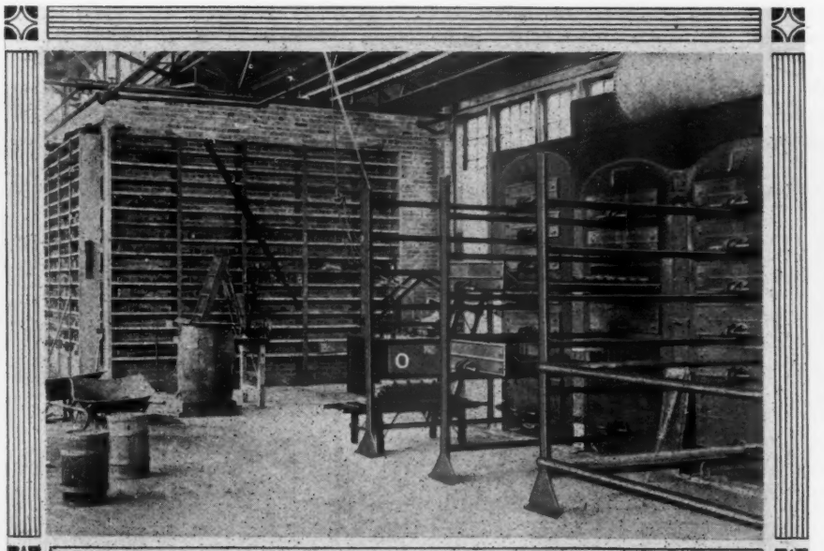


FIG. 7—PLAN OF CLEANING ROOM, SHOWING ARRANGEMENT OF EQUIPMENT

Fig. 1 shows a floor of 38-inch cultivator wheels being made on a pair of Pridmore stripping plate machines. Three men are employed on this job; one operates the cope machine, another the drag machine, while the third, a laborer, assists in handling the work. A special traveling crane equipped with an air hoist is employed to lift the flasks and to move the molding machines along the floor as the work progresses. With the aid of this equipment, the three men are able to make and pour off 46 molds per day. Similar equipment furnished by the International Molding Machine Co. is used for molding plow wheels.

The hand crane illustrated in Fig. 1 has a number of special features. Its span is 18 feet and its capacity 1½ tons. The beam is a heavy timber framed as indicated in the illustration. The wheels are extra large, 20 inches in diameter, with a single instead of the usual double flange. They run on roller bearings and the crane may be handled with unusual ease.

The arrangements for storing, handling, melting and pouring the metal constitute one of the chief features of this plant. Before the shop was built the surface of the ground lay about as indicated by the dotted line in Fig. 3. The earth lying over the grade established for the molding floor was excavated and used to form a fill 400 feet long, 85 feet wide and 18 feet high behind the cupola room. The elevated yard thus formed is spanned by a 10-ton gantry crane and is utilized for the storage of pig iron, coke, scrap, limestone, etc., which is delivered from the railroad cars at the charging floor level. The fill is held in place along its south edge by a concrete retaining wall. A view along the



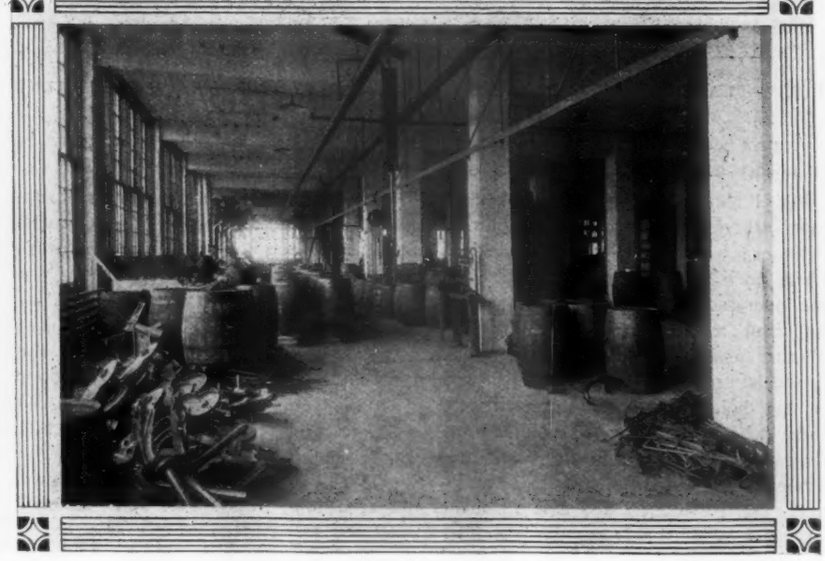


FIG. 8—CORE ROOM, SHOWING SHELF OVENS AND OIL TANK

FIG. 9—CHARGING FLOOR, SHOWING TRUCKS AND COKE MONO-RAIL

FIG. 10—SHIPPING DEPARTMENT IN CLEANING ROOM

top before the gantry crane was installed is shown in Fig. 13; the coke is stored under cover in the shed in the background.

A special overhead trolley connects the coke shed with the charging floor, and the fuel is brought to the cupola in the buckets illustrated in Fig. 9. The coke track is provided with a scale for weighing the charges. The pig iron is loaded by a magnet suspended from the gantry crane into the three wheel charging buggies illustrated in Figs. 9 and 13. The latter have a number of special features. The body is pivoted to the structural steel frame in such a manner that it balances and the load may be easily dumped through the charging door. Two of the three wheels are rigidly fastened on an axle, while the third swings freely in a swivel. This design was adopted for the purpose of providing a truck which could be moved with minimum effort and also be easily steered around sharp corners and into congested places. The truck is pushed, with the third or pivot wheel leading; the latter is mounted like a caster so it will track properly. The iron yard has a capacity of about 5,000 tons and the coke shed will hold approximately five carloads.

Charging Floor

The charging floor, Fig. 9, is reinforced concrete designed to support a load of 400 pounds per square foot. It has an area of 2,385 square feet, being 53 feet long and 45 feet wide. The iron is melted in two 80-inch cupolas, Fig. 4, the blast being furnished by two motor-driven, No. 6½ Roots blowers located on the charging floor. A Sly cinder mill is used to recover the iron contained in the cupola drop.

Trolley ladles distribute the melted iron throughout the shop, the general design and arrangement of the trolley tracks being clearly indicated in Figs. 1, 2 and 4. One track extends the full length of the shop through the north aisle while a similar one covers the south aisle. Both of these are so situated that they also serve the center bay. A special truss carries a connecting track across the middle of the shop as indicated in Fig. 3. Small hand ladles are used to carry the iron from the trolley ladles to the molds and each molder pours off his own work. A special coke-fired oven is provided for drying out the hand ladles.

A mixture suitable for light agricultural casting is melted; it contains approximately 2.15 per cent silicon, 0.5 per cent manganese and 0.8 per cent

sulphur. About 3.5 per cent steel scrap is charged with the pig iron and foundry scrap constitutes about 30 per cent of the mixture.

Sand Bins

A series of special concrete sand bins, Fig. 14, are situated in the retaining wall along the north side of the iron yard. A cross-section of one of the bins is shown at the left in Fig. 3. The various grades of sand are stored separately and three-wheel trucks similar to the charging buggies are employed to carry the material from the bins to the molding floor. The sand is received at the plant in cars on the elevated track indicated in Fig. 14 and is unloaded through chutes directly into the bins. The space between the foundry and the elevated iron yard is utilized for flask storage, a roadway being kept clear along the side next to the sand bins.

The overhead trolleys in the foundry not only handle hot metal, but also transfer finished castings from the molding room to the cleaning department. The latter is situated in a separate building and is equipped with tumblers and grinders arranged as indicated in Fig. 7. The mill equipment, which was furnished by the W. W. Sly Mfg. Co., Cleveland, includes 16 tumblers ranging in size from 42 x 42 x 60 inches square, to 24 x 44 inches, cylindrical, and five double emery grinders. The tumblers are driven through shafts and belting by a 50-horsepower motor and are also provided with an efficient dust collector system. A special 25-horsepower motor is used to drive the grinders which are situated between benches along the west wall of the cleaning room. The grinders are arranged to operate at different speeds for various classes of work; two sets run 1,050 revolutions per minute, two others at 1,300 and the fifth, 1,750 revolutions per minute.

The cleaned castings are sorted on the benches shown at the left in Fig. 12 and then are transferred to a monorail which carries them to the assembling department several hundred feet west of the foundry. The smaller pieces are packed in barrels, while the large ones are suspended singly from the trolley hooks. In order to handle the barrels and castings expeditiously, an air hoist is located over the scales as indicated in Fig. 10.

The arrangement of the equipment in the core room is illustrated in Figs. 5 and 8. The coremakers work at benches which extend around two sides of the room, while the ovens are situated along the south wall adjoining the foundry. There are two night

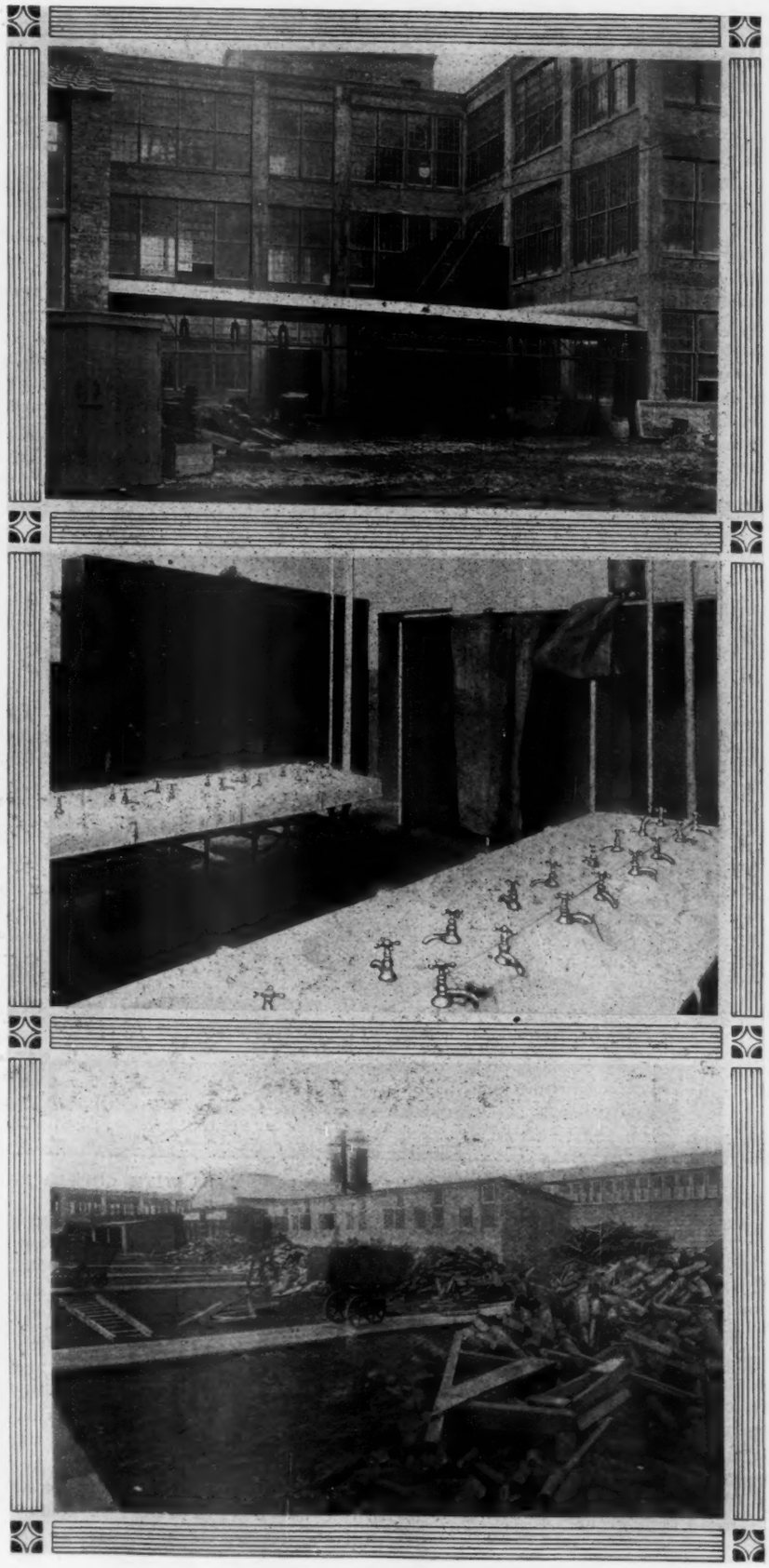


FIG. 11—TROLLEY CONNECTING CLEANING ROOM WITH FOUNDRY

FIG. 12—ONE OF THE WASH ROOMS

FIG. 13—THE IRON STORAGE YARD

ovens, each 8 feet wide and 12 feet long and three Whiting shelf ovens, arranged as indicated in Fig. 5. A 5-foot fire pit is excavated between the two sets of ovens. Shelves for carrying core boxes are placed around the wall of the wash room, which extends into the core room. One of the chief features of the core room is the oil tank, *O*, Fig. 13, furnished by the S. F. Bowser Co., Fort Wayne, Ind. It is built of riveted steel and is provided with a self-measuring pump which keeps a record of the core oil consumption. The use of this apparatus is said to have resulted in an appreciable decrease in the amount of oil purchased.

For the convenience of the men, there are two locker and washer rooms,

The Use of Chills

By W. J. Keep

Question:—We have been experiencing some trouble with chills used for casting iron rings, which are 4 feet in diameter, 12 inches deep and 3 inches thick. Frequently the chills, which are 3½ inches thick, will break before the rings are set. Also, we would like to have a suitable mixture for car wheels and chilled castings.

Answer:—As you do not state the depth of chill required, we will assume that it is ¾ inch. Back of this would be ordinary gray iron, 2¼ inches thick. The cracking of the chills is caused by the expansion of the rings immediately after the metal is set and undoubtedly while the central part of the casting is still partially fluid. The remedy is to use a mixture which will not expand sufficiently to cause the casting to touch the chill again after it first shrinks away from it. The chilling effect occurs almost instantly and the shrinkage of the casting and the expansion of the chill will cause the two to separate immediately after the iron has come in contact with the chill. This occurs, of course, when the expansion of the chiller is so small that it will not again come in contact with the surface of the metal to be chilled. Reducing the silicon to the lowest possible percentage consistent with the required depths of both the chill and gray iron, and reducing the phosphorus as low as practical, will accomplish the desired result. The chill is often removed from the mold just before the expanding casting overtakes the chill, but when making such deep rings this may not be practical. To overcome your difficulties, it is advisable to prevent the expansion of the metal as much as possible. Sulphur increases the chill and both sulphur and manganese decrease the expansion.

The analysis of cast iron car wheels follows: Silicon, 0.70 to 1.00 per cent; phosphorus, 0.30 per cent; sulphur, 0.05 to 0.10 per cent; manganese, 0.40 per cent, and total carbon, 3.90 to 4.20 per cent.

Chilling irons are generally used for making chilled castings, but the chill test should be made several times during the heat. A chill piece bedded in the sand on end, against which the iron is poured, will serve the purpose. Usually the chiller and the test piece are 1½ inches thick, about 6 inches long and 3½ inches deep. A chill test of this kind, however, is only comparative. The chill pieces can be made of any desired dimensions, but they should be of such form that they can be easily broken. However, the form of the chill test piece should never be changed after it is once adopted. A record of depths and character of chills and the chemical composition of the mixtures used will soon indicate the kind of iron practical for this purpose.

FIG. 14—FLASK YARD AND SAND BINS WITH CUPOLA ROOM IN THE REAR

Fig. 12, one being located in the core room and the other in the passageway between the foundry and the cleaning room.

The foundry was built from designs made by W. C. Squier, works manager of the Emerson-Brantingham Co., with the co-operation of S. B. Hendricks, general superintendent, and Eugene Garey, foundry superintendent. The general features were also supervised by C. S. Brantingham, president of the Emerson-Brantingham Co.

During October, November and December, 1912, manganese ore valued at $51,812 was exported to the United States from Madras, India.

Casting Cleaners' Wages on the Premium Basis*

A Large Western Steel Foundry Has Developed a System for Extra Wage Payment for the Employes of Its Cleaning Department.

By A W Gregg

THE STEEL foundry referred to in this article is connected with a manufacturing establishment which builds steam and electric shovels, several types of dredges, pile drivers, dragline excavators and other heavy machinery. The castings made vary from a few pounds to 10 and 11 tons each. Only a little over one-third of the work is standard, and even the so-called standard work is subject to frequent change in the course of improvement in design. In other words the work is practically that of a jobbing foundry.

The premium system of payment was introduced for molding several years previous to the proposal to use it in the cleaning room. Molding rates are set on individual jobs after time study, the rate being obtained by adding 60 per cent to the proper time to do the job, the bonus to the molder being one-half the time saved. This gives a man doing the work in the proper time an increase in pay of 30 per cent. The proper time is considered to be the time in which the average good man, working under average good conditions, can do the job, no account being taken of unfortunate circumstances, such as breaking a core, delay for the crane, etc.

How the Foreign Labor Was Interested.

The labor employed in the foundry cleaning room is nearly all foreign-born; about one in 20 of them speaks English, and grave doubt was entertained as to the possibility of making this class of labor comprehend the idea of a premium rate. If this fear had been well-founded no results could have been accomplished because the object of setting rates is to increase production and this object is defeated unless the men strive to earn premiums. Also, any premium paid to a man who is not striving to earn it, is a gift. Experience quickly proved that these men could grasp the idea of increased pay for increased output, and that they were more than anxious to earn the extra money. Undoubtedly the fact that the molding was rated made is far easier to secure the co-operation of the men when rates were set in the cleaning room, as it was generally known among the chippers that the molders earned good wages through the premium system.

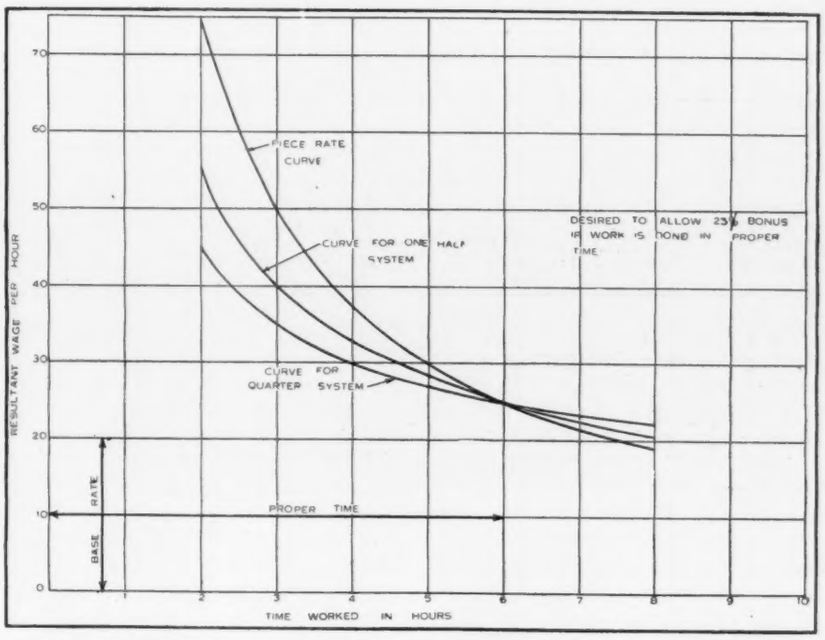
The method of premium payment, as finally adopted for the cleaning of castings, will be first described, followed by an explanation of the steps by which it was developed. The work is divided into five natural classes, sand-blasting, saw work, sledge and cold-cut work, grinding and air hammer work.

The basis selected for setting rates was weight, and curves have been developed expressing the rate plotted against the weight of the casting for the air hammer, grinding and sledge work. The rate is the proper time to do the job plus 100 per cent, the bonus to the man being one-quarter of the time saved; thus permitting a man who does the work in the proper time to earn an increase of 25 per cent in wages. The selection of 25 per cent, which has proved to be ample, was caused by a desire to play safe, for the nature of the work makes it very difficult to determine the proper time. The method of rating sand-blasting and sawing will be mentioned later, as they are handled in a different manner from the other three.

A timekeeper records the work for each man precisely as if the rates were set to pattern mark, keeping a record of the time in which each job is done. The time card has a space for the weight of the casting after its pattern mark, and this is filled-in by the time-checker, who then gets the rate from the proper curve and marks it on the card.

The time put in by each man each day is subtracted from the sum of the time limits for the work completed on that day, and one-quarter of the difference is awarded to the man as a bonus.

The premium system of payment has added two men to the clerical force, a time-keeper and a time-checker. If the rates were set to pattern mark a third man would be necessary to make time studies and set rates, but the selection of weight



CURVES SHOWING VARIATIONS IN WAGES UNDER PIECEWORK, ONE-HALF AND ONE-QUARTER PREMIUM SYSTEMS

*Presented at the Buffalo meeting of the American Foundrymen's Association.

as the basis and the use of curves obviates the necessity of a rate setter. The points of interest are the quarter system of premium payment and the method by which the curves were developed.

The first experiments in setting rates in the cleaning room were made on the air hammer work. The time to clean a rather standard casting was carefully studied by the foreman, with two of the best and most intelligent workmen doing the work. After deciding on the proper time, 50 per cent was added, and this rate was given to the men with a careful explanation that half of the time saved would be awarded as a bonus. The output of these two men increased in such a gratifying manner that a dozen or more additional rates were set. After the first payday all the men began to ask for premium work. The curious discovery was made that it was not necessary to tell the men what rate had been set on a job. They were satisfied to know that a rate had been set, and to urge a man to his best efforts it was only necessary for the foreman to pull out his watch, point to a job and utter the magic word *premium*. The men from the start seemed to assume that the rates set would be fair and that hard work would be rewarded by increased pay.

The result of setting rates was so uniformly encouraging that more and more were set. For the first four months the foreman set all the rates and he and his assistant kept time on the work. By the end of this time, 75 per cent of the work going through was kept constantly rated and it was found necessary to employ a time-keeper. Also the task of setting so many rates was taking such a large share of the foreman's time that it was necessary to devise some wholesale method of rating or to secure a man to set rates.

The happy idea of putting the rating on a weight basis was suggested. During the first four months upward of 2,000 rates had been set, and the first step was to go over these rates to see if there was any definite relation between weight and rate. To do this the output per rate hour was calculated for each of the rates which had been set by time study. The rates plotted against the weight of castings gave a surprisingly smooth curve. Naturally, the output per hour in pounds increases very rapidly as the weight of the casting increases.

The curves were checked against the old time cards for several weeks and it was found that the premium earned by the gang as a whole averaged about the same with rates set from the curves as under the individual rates.

However, it was also found that the earnings of some men ran much higher and others much lower than under the old rates and that this variation did not altogether represent a variation in the ability of the men.

The curves, it seemed, would give the total premium earnings for the gang correctly, but the distribution to the individual laborer was not altogether equitable.

Several methods were considered to overcome this difficulty, but the one finally adopted was the quarter system. Previous to this time the curves had been based (as the individual rates were) on an addition of 50 per cent to the proper time and one-half of the time saved as a bonus.

With the quarter system, 100 per cent is added to the proper time and one-quarter of the time saved is paid as a bonus.

An example will probably be the easiest way in which to show that the quarter system will tend to neutralize the effect of a man getting a lot of jobs which require either more or less than the average amount of work. Suppose the proper time to clean the average casting from a certain pattern is 10 hours. The accompanying table shows the percentage of premium earned under both systems under three different conditions: First, work done in proper time; second, done in much less than the proper time; third, work done in more than the proper time.

Under the quarter system it is evident that a fortunate run of work will not so materially increase a man's earnings, nor will an exceptionally unfortunate run of work so materially decrease them.

APPLICATION OF THE PREMIUM SYSTEM

	Proper time.	Premium rate.	Bonus earned if job is done in proper time. Hrs. Per cent.	Bonus earned if job is done in 4 hours. Much less than proper time. Hrs. Per cent.	Bonus earned if job is done in 12 hours. Longer than proper time. Hrs. Per c't.
One-half system	10	15	2½ or 25	5½ or 137½	1½ or 12½
One-quarter system...	10	20	2½ or 25	4 or 100	2 or 16½

To illustrate the same thing in a different manner, the curves in the accompanying illustration show the variation in wages under piecework, one-half premium system and one quarter premium systems resulting from doing a job in different lengths of time. The same conditions are used in each of the three cases, namely, a base rate of 20 cents and a bonus of 25 per cent if the work is done in the proper time. Where the proper time to do a given job can be determined with great accuracy, piecework or the one-half premium system will give the best results, because the reward for increased output and the penalty for decreased output are both greater. But where, as in the case of cleaning castings, the nature of the work makes it impossible to determine the proper time with certainty, the quarter system will give the most satisfactory results, because fortunate jobs will not increase the bonus earned so rapidly, and neither will unfortunate ones cut off entirely the chance to earn premium. It will be noted also that the curves show that the disciplinary effect of the quarter system very nearly approximates that of the one-half system.

Sand Blast and Saw Work

Air hammer work, sledge work and grinding are all rated by this method of curves and quarter system, the rates being based on the output per hour in pounds. Sand-blasting and saw work are rated in a different way. The sand-blast work had been rated at a definite price in cents per ton for several years previous to the rating of chipping and grinding, and as this was considered to be satisfactory it was not changed. Rating the saw work was a comparatively easy problem, the rate being based on the lineal inches cut per hour and the one-half premium system being used.

Reduced cost and increased output are the principal benefits obtained. The output per man in the case under discussion has increased about 60 per cent since the men have had an incentive to exert their best efforts. The increase in the average wage has amounted to about 20 per cent. The change in the attitude of the men toward their work is well illustrated by the fact that they are now using, at their own request, sledges which are three pounds heavier than they had been using before. When working under the old system the foreman was very often compelled to discharge men for grinding sledges on an emery wheel to make them lighter.

Molding Large Mower Frames by Machine

How a Specially-Designed Stripping-Plate Machine is Employed for Molding These Large, Irregularly-Shaped Castings

IN THE early days of the implement business mower frames were molded by hand and ten flasks a day was considered a good rate of production for two men. With the advent of the molding machine the efficiency of labor was practically doubled and the losses traceable to poor workmanship were greatly lessened. But foundrymen are now learning that they have only explored the borderland of possibilities in machine molding and some of the most valuable developments of the day are in connection with improvements and advances in molding machine practice.

Along this line the work recently done by the Emerson-Brantingham Co., Rockford, Ill., is of interest. This company manufactures a full line of farm implements and the difference between ordinary and advanced methods in attacking molding machine problems is pertinently illustrated in its foundry practice.

Figs. 1 and 2 show how mower frames are molded on Pridmore stripping plate machines. The general nature of the casting is indicated by the pattern on the machine in the center of Fig. 2. The frame is in the shape of an irregular triangle, cored out to form a housing for a pair of shafts and a number of connecting gears. Its overall dimensions are about 24 x 36 inches and at no point does the metal thickness exceed ½ inch. The casting weighs 150 pounds.

Its size and shape are such that the pattern can be fitted to a stripping plate machine with comparative ease, although not lending itself readily to the rock-over type. But if the ordinary stripping plate methods were used, it would be necessary to fix bars in the drag in order to retain the sand while the flask is being lifted off the machine and rolled over. This would add to the expense of the equipment and would also, it is stated, seriously interfere with the speed of the workmen.

To avoid these difficulties, the entire molding machine with the flask in place is turned over in the air with a crane before the pattern is stripped out of the drag. The machines are operated in pairs, one making copes and the other drags. The patterns are metal, carefully finished and cast iron flasks of special shape are used

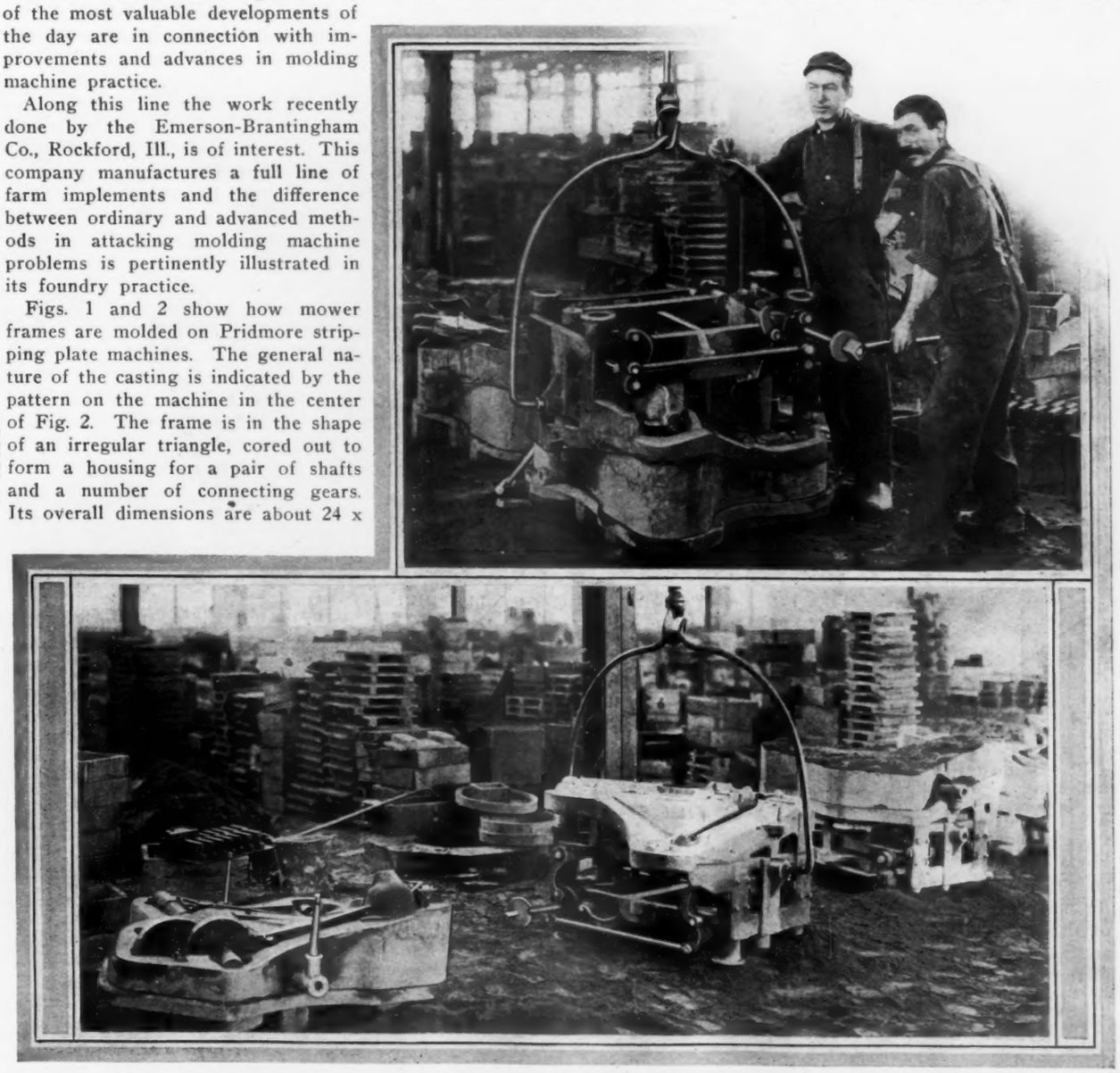


FIG. 1—STRIPPING PATTERN FROM DRAG AFTER IT HAS BEEN ROLLED OVER WITH THE MOLDING MACHINE
FIG. 2—MOLDING MACHINE ROLLED BACK IN POSITION FOR ANOTHER FLASK. THE DRAG HALF OF THE MOLD IS AT THE LEFT

as shown in the illustrations. Fig. 1 shows the molder in the act of stripping the pattern out of the drag after the latter has been rolled-over with the machine by an air hoist suspended from a small traveling hand crane. Before the machine is lifted from the ground, the bottom board is, of course, placed on the drag and everything is locked with quick-acting clamps.

In the center of Fig. 2, the machine is seen righted again with the pattern in molding position ready for a new flask. At the left in this illustration is the drag mold from which the machine has just been removed and at the extreme right is the cope machine with finished flask in position.

It will be noted that the cores are all made in green sand. As there are no bars in the drag, the ramming operations are extremely simple, the sand being merely walked off before the bottom board is set in place. This operation requires only one minute. The cope is made with bars and is handled in the usual manner.

Fig. 3 illustrates a small floor job cast with a chill. The casting is a part of an engine disc plow. The cope is shown in the center of the illustration, with the drag at the right and the pattern and bottom board for making the drag at the left. One of the chills is in place in the drag and an extra one is also shown in the foreground. The chills are machined and are oiled to prevent the condensation of moisture. The pattern is metal and the drag bottom board is made in dry sand. One man, working on the floor, makes and pours 46 molds a day.

Melting Difficulties

By W. J. Keep.

Question:—Our cupola lining lasts only six weeks, and we would like to know what we can do to increase its life. The cupola is lined to 42 inches and is provided with one row of tuyeres. The blast pressure varies from 10 to 14 ounces and the bed coke, which is lighted two hours before the iron is down, extends 18 inches above the tuyeres. The bed consists of 900 pounds of coke and the iron charges are one ton each, the coke for the first five charges consisting of 250 pounds; the next five charges, 225 pounds and the next ten charges, 200 pounds. The iron is fairly hot; 30 pounds of fluorspar are used per ton of iron.

Answer:—You are using twice as much flourspar as necessary and this cuts out the lining. You also can reduce your coke 10 pounds for the first 10 charges, and if the iron is still hot, continue to reduce the coke 10 pounds per charge until you are down to 200 pounds. You probably can cut the last two charges to 100 pounds each. When you use fluorspar as a flux you need about one-half as much as when you use limestone. Twenty tons is a long heat for a cupola of this size. You have made no statement regarding the slagging of your metal, and you must let the slag run out of your cupola through an opening at the back. If you keep the slag hole open, you will melt much faster, and you will not destroy the lining to such an extent as you would when you do not slag-off. However, you must expect considerable cutting with such large heats. You might reduce your blast pressure, which also will increase the life of the lining. However, do not reduce the size of the iron charges. Whatever changes you make you should introduce slowly. A number of similar questions have been answered in THE FOUNDRY during the past few months, and nearly the same question has been received regarding a 60-inch cupola lined to 48 inches, which melts at the rate of only six tons an hour. In this case, hard coke should be used.

Yale & Towne Building

The Yale & Towne Mfg. Co. has removed its general offices from 9 Murray street to 9 East Fortieth street, New York City. The new quarters were selected after long investigation as being the best suited to the convenience of customers and to promote the efficiency of the management. The building is located half-way between the great railroad terminals, in the heart of the hotel district and is accessible from all sections of the city. The site is 50 x 100 feet and the 12-story building was erected and is owned by the company. The ground floor is devoted to a series of exhibit rooms. The basement contains the city salesroom and the repair department, while the twelfth floor is occupied by the executive offices and the directors' room.

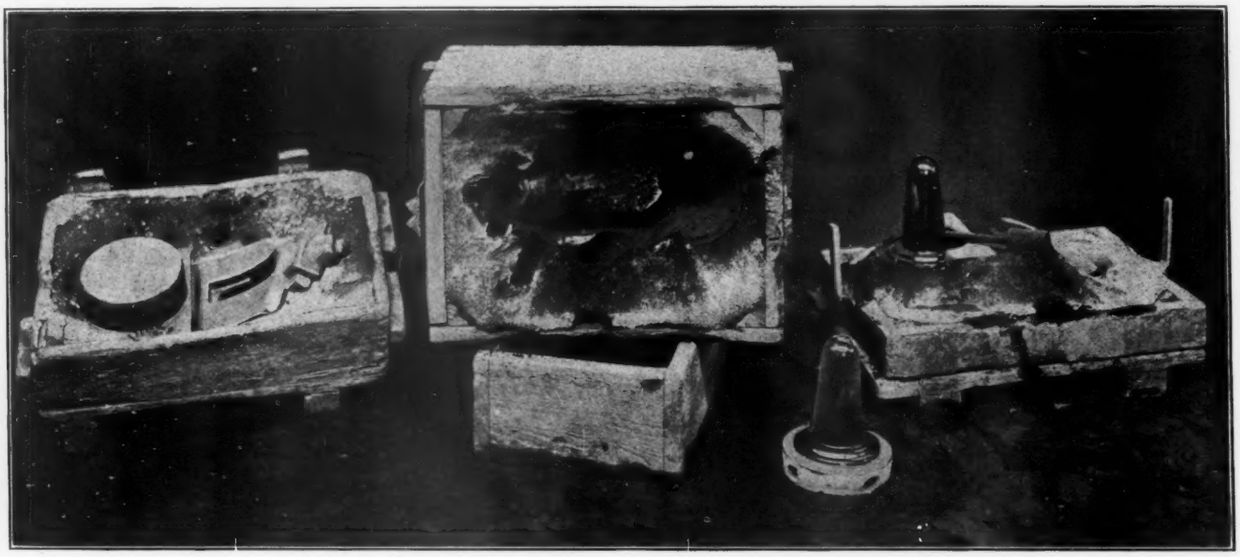


FIG. 3—PARTS OF MOLD FOR SMALL, CHILLED CASTING

In a 16-page folder, issued by the Pennsylvania Pneumatic Co., Erie, Pa., its extensive line of two-stage air compressors is illustrated and described. These machines are built in capacities of 100 to 500 cubic feet per minute at 60 to 100 pounds pressure.

Applying Chemistry in the Plating Room---III

Various Methods for the Estimation of Copper in Plating Solutions With Examples and How to Solve Them

By E P Later

AMONG the metals which are extensively used in electroplating, copper stands out conspicuously. Its power of giving protection against corrosion, especially to iron and steel, the readiness with which it lends itself to the production of oxidized finishes and the ease of plating, all tend to make it an extremely useful metal to the plater. Regarding the readiness with which it can be plated, it is well-known that it will deposit on iron or steel by simple immersion, without the aid of an electric current, although a deposit obtained in this manner is porous and inferior in some ways to that produced by a regular plating operation.

Copper Solutions

According to the requirements of the case, copper is deposited either from an acid or alkaline, cyanide solution. The former consists essentially of a solution of copper sulphate with a slight amount of free sulphuric acid present. A commercial basic carbonate or sulphate of copper is used for making the bath and its preparation presents no difficulties.

The operation of such a solution, however, is not practicable in all cases, since the free acid present attacks some metals and prevents deposition altogether or gives an unsatisfactory, powdery deposit. For example, zinc, iron or tin easily decompose copper solutions by simple immersion and are, therefore, best plated in a cyanide solution. As its name implies, this consists of copper salts present as the double cyanide of copper and potassium or copper and sodium, together with certain other chemicals which assist in producing a good deposit. Such a solution will not attack the objects to be plated and gives a fine deposit in considerably less time than is required by an acid bath. For these reasons it is extensively used although it is not entirely free from objectionable features.

There are several methods of estimating copper in solutions, and one of the simplest is by the use of a standard solution of potassium cyanide. Weigh out 16.82 grams of potassium cyanide, dissolve in a small quantity of distilled water and dilute to 1,000 c. c.

Prepare a standard solution of copper sulphate, Cu SO_4. $5H_2O$, containing 16.129 grams per litre. Take out 10 c. c. of this solution with a pipette and run into a large breaker. Add 50 c. c. distilled water and ammonia slowly until the green precipitate changes to a dark blue solution.

Potassium Cyanide Method

Add slowly from the burette the cyanide solution to be standardized until the deep blue solution pales to a yellow color with a violet tinge. This indicates that nearly all the copper is titrated and only 0.3 c. c. or 0.4 c. c. more of cyanide are necessary. Then add 100 c. c. of distilled water to the solution and allow it to stand a few minutes. Next add cyanide solution, drop by drop, stirring until the violet tinge has almost entirely disappeared.

Theoretically, 1 c. c. of cyanide solution (16.82 grams to a litre) is equivalent to 0.01613 grams of copper sulphate, Cu SO_4. $5H_2O$.

Since 1 c. c. of the copper solution (16.129 grams to a litre) equals 0.0161 grams of copper sulphate, 10 c. c. should require $0.1613 \div 0.0161 = 10$ c. c. of standard cyanide solution. In any case, the value of 1 c. c. of the latter in terms of copper sulphate may be found by dividing the number of grams of the latter taken for test by the number of cubic centimeters of cyanide solution required.

Thus, if 10 c. c. of copper solution, equivalent to 0.1613 grams of copper sulphate, were taken and 14.5 c. c. of cyanide were required, the value of 1 c. c. of the latter $= \frac{0.161}{14.5} = 0.0111$ grams of copper sulphate.

It should be borne in mind that crystallized copper sulphate contains five molecules of what is called water of crystallization, and the weight of these must be considered in calculations. If the ordinary blue crystals are heated gently, this water is driven off and the salt crumbles to a white powder, which will again take up water and turn blue. The molecular weight of this white powder, anhydrous copper sulphate, Cu SO_4, is 159.64, while the molecular weight of the ordinary blue crystals is 249.72, so it can be seen that a serious error might be caused by taking the wrong weight. Therefore, in all of the subsequent calculations the weight of Cu SO_4. $5H_2O$, which equals 249.72, has been used.

The value of the cyanide solution has been expressed in terms of copper sulphate in order to simplify calculations later on. If it is desired to know the value of the solution in terms of metallic copper, it may be found by multiplying the value in terms of copper sulphate by 0.254. Thus, if 1 c. c. of the solution is equivalent to 0.0111 grams of copper sulphate, $0.0111 \times 0.254 = 0.00282$ equals the value of 1 c. c. in grams of metallic copper.

For copper in an acid copper solution the following determination should be made:

Pipette 10 c. c. of the solution into a beaker, add 50 c. c. of distilled water, and then ammonia slowly, until the green precipitate just dissolves to a clear blue solution. Titrate slowly with the standard potassium cyanide solution, stirring thoroughly until the blue color fades into a yellow with violet tinge. It is important that this point be watched closely and should be determined as accurately as possible.

Dilute with 100 c. c. of distilled water, let stand a moment and add cyanide, drop by drop, until the violet tinge just disappears.

Calculation of Results

If the cyanide solution is of such strength that each cubic centimeter is equivalent to 0.0161 grams of copper sulphate, the result may be expressed in ounces of copper sulphate per gallon by multiplying the number of cubic centimeters of cyanide required by 0.214.

If it is not of this strength, the following formula may be used: $Y \times Z \times 1.33$ equals ounces of copper sulphate per gallon, when Y equals number of c. c. of cyanide required and Z equals the value of one c. c. of the latter in grams of copper sulphate.

For copper in cyanide copper solutions, the following determination should be made:

Pipette 10 c. c. of the solution into a beaker and add 10 c. c. *aqua regia* (1 part nitric acid to 3 parts hydrochloric acid). This operation gives off

very poisonous fumes and should be performed under a hood. A white precipitate will form, but soon re-dissolve to a green solution; if necessary, more *aqua regia* may be added. When all is in solution, heat gently until it begins to boil, then continue heating 10 minutes. Add distilled water to bring the bulk to 100 c. c., and ammonia, until the green precipitate just re-dissolves to a blue solution and then determine copper as before. The calculations are made as in the preceding case.

Copper Plating Solution

There are many formulas for copper plating solutions, and each plater has his own particular one which he thinks, and doubtlessly rightly, is best suited for his purposes. Solutions vary considerably owing to the demands and requirements to be met. Therefore, when a solution is working satisfactorily, a test should be made to determine the amount of copper present. The result may be expressed either as metallic copper or as copper sulphate, in per cent or ounces per gallon, but it is important to be consistent in this and always report the same way. That is, do not report one determination as per cent of metallic copper and the next as ounces of copper sulphate per gallon.

When the proper metal content of the bath has been found, it may easily be kept at this point by testing frequently and adding the required amount of copper carbonate made into a paste with water, whenever necessary.

There is one point, however, which should not be overlooked, and that is the fact that commercial varieties of basic copper carbonate or sulphate are subject to a good deal of variation in their content of metal. Therefore, unless one knows the strength of his materials, he is liable to go somewhat astray in his maintenance of copper solutions, in spite of his best efforts. With copper as expensive as it is, the business-like way to buy its compounds is by specification or analysis; then a purchaser knows that he is getting full value for his money. An analysis is not expensive nor hard to make, and it may be the means of saving considerable money in the course of a year.

If the operator posseses or has access to a balance, he may determine the amount of copper present in copper salts by proceeding as follows:

Weigh out 1 or 2 grams of the dry and powdered salt and place in a small beaker. Add about 50 c. c. of distilled water and enough nitric acid to take everything into solution. When this is accomplished, pour the solution into a clean, 100 c. c. volumetric flask and make up to the mark with distilled water. Ten cubic centimeters of this solution should then be taken and the copper determined as in the preceding methods.

If 1 gram was taken for analysis, dissolved and diluted to 100 c. c. and 10 c. c. of this solution titrated, it is evident that this represents 0.1 gram of salt. Knowing the number of cubic centimeters of standard potassium cyanide required and the value of each cubic centimeter in terms of copper sulphate, the per cent of the latter in the sample tested may be found by multiplying the value of 1 c. c. of cyanide by 10 times the number of cubic centimeters required (since only 0.1 of a gram was actually titrated) and pointing off two places to the right. If it is desired to express the result as metallic copper, the per cent of copper sulphate should be multiplied by 0.254.

An example may serve to make the calculation clearer: Suppose 1 gram of salt was taken, dissolved and diluted to 100 c. c. and 10 c. c. titrated as described, 5.9 c. c. of standard cyanide being required. Each cubic centimeter of this should be equivalent to 0.0161 gram of copper sulphate, therefore, $0.0161 \times 5.9 \times 10 = 0.9499$ gram, or 95 per cent copper sulphate. For inspection purposes, it would probably be better to express the result as metallic copper, which may be done by multiplying by 0.254. Then $95 \times 0.254 = 24.13$ per cent. As a suggestion, a good grade of copper carbonate should contain approximately 48 to 52 per cent of copper.

Electrolytic Method

It should be remembered that the ordinary commercial copper salt is a mixture of basic carbonate and sulphate of copper and varies considerably in composition. For one thing, it contains much less water of crystallization, and consequently is relatively higher in copper content. A little reflection will show that an analysis of such material, when calculated as crystallized copper sulphate, $Cu\ SO_4 . 5H_2O$, might show a percentage of considerably more than 100 per cent of the latter, so that expressing the result as metallic copper is less misleading.

Perhaps the most widely used method of determining copper is the electrolytic. As the name implies, the metal is precipitated or plated by the electric current onto some object which is weighed before and after the operation, the increase in weight representing the amount of metallic copper present in the solution or sample tested. It is so accurate and easily carried out that it may be well recommended in all cases where a high degree of accuracy is required.

For this determination a platinum cone or wire screen and a wire spiral are generally used and may be obtained at any large supply house, or the spiral may be made by the operator himself by taking a piece of heavy platinum wire, 6 or 8 inches long, and coiling it in the shape of a hair spring, leaving one end project up from the center a distance of 2 or 3 inches. At present platinum is very expensive, so it would be cheaper to use a gold wire and probably as good results will be obtained, although it has certain disadvantages. In fact, a silver wire may be heavily gold-plated and can be made to give good service.

Ordinarily, this spiral is made the anode during the analysis and the cone receives the deposit. Occasionally, however, the vessel containing the liquid is made the cathode and the metal is deposited on it. In this case the vessel may be made of platinum, gold or silver, heavily plated with gold. The main requirement is to get a spiral or dish of some metal which is not attacked by ordinary acids or alkalis.

The source of current may be batteries, two or three Daniell or gravity cells being used, or the regular plating current may be employed. Copper wires wrapped around the anode and cathode bars of a plating tank serve to conduct it to the apparatus. In that case it is advisable to connect delicate volt and ammeters in circuit, so that the proper conditions may be obtained.

An example or two will serve to illustrate the process:

Weigh out about 1.5 grams of basic copper carbonate into a beaker, add 200 c. c. of distilled water and strong nitric acid, until just barely acid, then 2 c. c. in excess, and stir gently with the platinum spiral, finally leaving it in the beaker.

The Process

The cone is previously cleaned by immersing for a moment in hot potash, rinsing in distilled water, then in alcohol and dried in a hot oven and finally weighed. Care must be taken that nothing touches it, not even the fingers, after it is dry. The cone is then lowered into the liquid over the spiral, taking care that they do not touch each other.

They are now connected to the source of current, the cone being connected to the negative or cathode side. A current of 0.5 to 1 ampere is passed through the solution. The copper gradually deposits on the cone and the solution becomes paler and paler until it finally appears colorless. Since it ordinarily

requires several hours for the completion of the operation, it may be allowed to go on over night. Of course, a stronger current would hasten the test considerably, but the deposit is apt to be *burned* and less coherent, so that there is danger of losing some while washing. To determine whether the deposition is complete, one or two drops of the solution are withdrawn by a pipette and touched with a drop of potassium sulphide solution (copper oxidizing solution). Absence of a black color is evidence that no copper is present.

The cone is carefully raised out of the liquid before breaking the current and is washed by a jet from the wash bottle. It is then dipped once or twice into alcohol, placed in a hot oven for a few minutes and weighed, after allowing it to cool.

The gain over the previous weighing is the weight of pure copper in the sample taken, and from this the per cent may be easily calculated.

As an example, suppose the following data were taken in an analysis of commercial copper carbonate:

Weight of salt taken, 1.5 grams	Grams
Weight of cone after electrolysis	25.7243
Weight of cone before electrolysis	25.0143
Weight of copper.....	0.7100

$$\frac{0.71 \times 100}{1.5} = 47.33 = \text{per cent of copper in the sample.}$$

Electrolytic Method.

The metallic content of a plating solution may be determined electrolytically as follows:

Pipette 10 c. c. of the solution into a beaker, add 2 c. c. of strong nitric acid and enough distilled water to cover the platinum cone, then put the spiral and cone in place as described and proceed with the test. When the deposition is complete, the cone should be removed, rinsed with distilled water, dipped in strong alcohol, then dried and weighed.

Multiplying the increase in weight of the cone by 100 gives the grams of copper in 1 liter of the solution. If desired, it may be expressed as ounces of metallic copper per gallon by multiplying by 0.133.

An electrolytic apparatus wherein the containing vessel is made the cathode is probably cheaper to procure inasmuch as it does not have to be made of platinum, since a silver or nickel dish heavily plated with gold will give good service.

When using this form, the manipulation is essentially the same as in the preceding case. The dish is carefully cleaned, dried and weighed, then the electrolysis is carried out, using the spiral as the anode. When the deposition is complete, the vessel is emptied, washed with distilled water, then rinsed with strong alcohol, dried in an oven and weighed again and the necessary calculations made. The copper deposit may be removed from the dish or spiral by placing these in dilute nitric acid for a few moments.

DIFFICULTIES OF THE PLATER

The Reason Why and the Remedy

Brass Finishes

We desire a bright black finish which will be quite durable on brass and also wish to finish brass goods to resemble old brass; another line calls for a matte surface with antique finish. Will these finishes require three separate solutions for their production?

To produce a bright black on brass will require a polished surface to begin with. Then clean the brass and strike in a nickel solution for a moment, rinse and immerse in a solution made as follows: In as small amount of water as possible, dissolve 4 ounces of pure caustic soda, and in this solution dissolve 8 ounces of white arsenic by boiling. When the arsenic is completely dissolved, add the solution thus obtained to 1 gallon of hydrochloric acid and add 10 ounces of sulphate of nickel previously dissolved in as little water as possible. Then stir well. Use clean, old nickel anodes with a tension of about 3½ volts.

For the old brass, the above may be used and the work brushed, or dissolve 8 ounces of white arsenic in 5 ounces of caustic soda and a small amount of water; when solution is complete, make up to 1 gallon by the addition of water. Then add ¾ ounce potassium cyanide to each gallon and use wrought iron anodes with three or four volts tension, according to the distance between the work and the anode.

To obtain a matte surface for the antique finish, use 1 gallon of nitric acid and 2 gallons of sulphuric acid. Pour the sulphuric acid into the nitric acid, never the reverse, and then add about 1 ounce of muriatic acid to each gallon of the mixture and a small quantity of zinc sulphate. Obtain the antique finish by using the above formula for old brass or dispense with the matte dip and scratch brush with pumice and water. Then get the old brass finish and relieve with the scratch brush and pumice. The effect thus obtained resembles the matte surface secured by other methods and may answer your purpose.

Cleaning Solution for Brass

We would like to have a formula for a solution to remove dirt and grease from brass that is to be plated.

Nearly all of the platers now use preparations which are purchased from the various supply houses and which are more or less adapted to cleaning brass prior to plating. The following formula gives good results and can be easily made: Crude potash, ½ pound; rosin, ¼ ounce; cyanide of potassium, ¼ ounce, and water, 1 gallon.

Use this solution boiling hot and after the brass has been immersed for a few minutes remove and rinse in clean, cold water. Next immerse the brass in a potassium cyanide solution consisting of ½ pound of potassium cyanide for each gallon of water. Rinse again and plate. Some work may require swabbing with a cotton brush after it is removed from the cleaning solution and after having been rinsed. A simple solution of caustic soda, ½ pound, and water, 1 gallon, is often used for this purpose. Prepared lyes nearly all contain more or less caustic soda or caustic potash. A simple solution of either of these chemicals may be made effective by the addition of either rosin of potassium cyanide in small quantities.

To clean brass by the aid of the electric current, try the following: Caustic soda, ½ pound; sal-soda, ½ pound; rosin, ¼ ounce, and water, 1 gallon. Use from four to eight volts and a cur-

rent density of about 12 amperes. The greater the current density, the more rapidly the cleaning is performed. The solution should be maintained at a temperature of about 120 degrees Fahr. Avoid the use of mineral oils or fats in the polishing treatment, as they are exceedingly difficult to remove. On the other hand, animal fats, such as tallow, should be employed, which is easily sponifiable in ordinary lyes. This suggestion, if followed, will greatly simplify the cleaning of brass or other material preparatory to plating. Some platers prefer to use a 5 per cent solution of hydrochloric acid and water as a dip for brass previous to plating, instead of the potassium cyanide solution mentioned. Any cleaning solution to be effective, however, should be used hot.

Copper-Plating to Size

We have a number of automobile pinions which have machined too small for the inside bearing and the workman responsible for the error has suggested copper-plating the pinions to size. We prepared a solution and attempted to plate them, but failed to obtain a smooth deposit and the copper came off easily, leaving the metal underneath in a worse condition than before it was plated. The bearing is now 0.005 *inch too large for the ball cage and is useless for our purpose. Is copper plating practical?*

Plating machined surfaces to size has been employed extensively by certain makers of moderate-priced cars, but it has never given entire satisfaction. In a case such as yours, the bearing being pressed in has little chance to work free if the copper deposit is perfect and the bearing cage is fitted tightly. Proceed as follows: Make wooden plugs and insert them in the opening of the stem at the bearing end so that the top of the plug is flush with the bottom of the bearing cavity. The plugs must be fitted water-tight. Bore holes the size of the pinion stem in a 6-inch or 8-inch board to accommodate as many pinions as you wish to treat at one time. Rest each end of the board on a box or bench and insert the pinions with the bearing upward. Then connect them by wire to the negative pole of a plating bath employing not more than two volts, or introduce a resistance to obtain the same effect. From the board holding the pinions arrange upright supports to carry the positive electrical conductor from which small anodes of copper are suspended. When all details are attended to as to equipment, remove the pinions and clean the bearing thorougly. Then apply a deposit of copper in a cyanide copper bath, which is preferably used hot. When the surface of the articles is well covered, remove and rinse them in cold water and allow them to cool before they are removed to the board where they are placed in position and the bearing is filled immediately with acid copper solution which should be prepared prior to arriving at this stage in the treatment. The solution consists of a copper sulphate solution registering 18 degrees Baume, to which is added sufficient sulphuric acid to increase the density to 20 degrees. The anodes should be arranged so that they are equi-distant from the circumference of the bearing and employ as great a volume of current as possible without causing the deposit to become dark or sandy. In appearance, the copper deposit should be velvety and pink. Owing to the very large cathode surface and small quantity of solution, the liquid becomes exhausted of metal quickly and it is advisable to renew the solution frequently in order to facilitate a rapid deposit. If the anodes become coated with slime, it indicates too high voltage. They should work clean and keep bright. If the bearing is 0.005 inch large, a deposit of 0.0025 on either side will suffice for a fit, but it is advisable to deposit a little extra as the copper will permit of a smaller size for a pressure fit and if found too small, it may easily be dressed down. The expense of this operation is trifling compared to the cost of the pinion and the results will be satisfactory if care is exercised in fitting the bearing cage.

Equipment and Management of Cleaning Baths

By Seymour W Rowsbar

POSSIBLY one of the most puzzling problems which may confront a plater is to account satisfactorily for various rust-covered, corroded spots upon the surface of iron and steel work when removed from the cleaning solution, even though immersed but a short time. The effect is not observed when two pieces of steel are suspended separately or free from contact with the tank, but when the bath is filled with work, the effect is quite pronounced and frequently a considerable quantity of work may have to be repolished to remove the blemish. The solution is said to be too weak or too concentrated, or perhaps the particular compound used is said to be unsuitable, but regardless of any change made in the solution, the trouble continues and the plater concludes that it is the "nature of the beast" and makes no further attempts to solve the problem. Possibly some friend may help him out, but we have met dozens who have tolerated such conditions for years rather than to strive in some way to prevent it.

The Cause and Remedy

The cause and effect are extremely simple and their removal equally as easy. The spots are caused by electrolysis and the damage, as usually noted, began and progressed while the parts were suspended in the potash solution. The actual power required to produce the defect might be very small, as a potential of 1/1000 of a volt is all that is required to induce ferric corrosion, though the source of current were located in a distant portion of the plant. A current of 0.3 ampere would ruin a thin steel tube in a few hours in the same manner. The very fact that the solution contains a caustic alkali or at least a base, is favorable to the action as these are fair conductors of electricity. Upon investigation, the tank will be found charged with positive electricity and the source of the current is almost invariably the plating dynamo.

When a current from a machine of higher voltage than used for plating enters a cleaning tank as a stray current, its effects are usually detected at once, as it generally reaches every tank equipped with either water or steam pipes. Entering the tank by way of the pipes, the current passes to the work suspended in the solution and in contact with the tank, at some point either beneath the surface of the solution or by means of the suspending rod. As it leaves each piece of work on its return to the generating source and meets with the resistance of the solution, the current will jump and the metal will be corroded at that place, and no corrosive effect

is noticeable where the current enters. Thus, if two pieces of steel are suspended together in the solution and one piece touches the tank, a corroded spot will form upon each piece where they are in contact, but the pipe conveying the current to the tank will not be attacked. The precipitate formed at the corroded spot is the sesquioxide or peroxide of iron, Fe_2O_3, plus 3 parts or 24 per cent of water and is red rust, $Fe_2O_3 + 3H_2O$.

Removal of Rust

Iron rust on a ferric surface never ceases its action so long as it is in contact with it and, therefore, unless the spot is noticed and removed, the subsequent electro deposit fails at this point. The covering of rust particles with a deposit of metal is useless and the plater should bear in mind the fact that "rust produces rust", whether beneath a coating of metal or paint, or exposed to the elements, the only difference being in the time required for the action. Iron immersed in caustic soda will not rust. Although the lye absorbs carbonic acid, it does not absorb oxygen.

We have in mind a case where the entire power plant and sprinkler system as well as a large stock of steel in the store room became charged with positive electricity and while the condition existed, the plater, unconscious of the leak, was daily complaining of the inadequate capacity of his generator, and because of sparking brushes and slipping, squeaking belts, he believed he was overloading his machine. In fact he was, but in an entirely different manner than expected. After being informed by an electrician that he was losing more current than he was using, insulated flange unions were placed in all pipes entering and leading from the various iron tanks and the circuit regained its normal equipoise.

This provision does not in all cases prevent the electrolytic corrosion of parts immersed, as the current may enter the tank by way of the wet floor and supports saturated with solutions. But if ordinary cleanliness is practiced, such would not be the case. However, in order to insulate the tank from stray currents, the flange unions are fitted with thick rubber gaskets, two to each union, and to protect the gaskets from the effects of steam, an asbestos, copper-lined gasket, slightly larger than the bore of the pipe, is placed between the two rubber gaskets and over the bore of the pipe, the bolts are insulated with fiber tubing and washers beneath the bolt head and nuts. Such a joint should remain in good condition under constant use for several years. Also, saturate ordinary bricks with paraffine wax and place between the floor and tank supports. Coat the entire surface of the supports with at least two coats of asphalt paint, and keep the floor in the vicinity of the tanks free from collections of dirt, wires or rubbish such as often finds its way beneath the tanks because of scarcity of floor space; finally, provide a hardwood frame to fit the top of the tank upon which to lay the suspending rods. These precautions apply to all iron tanks, whether equipped with the electric current or not.

When suspending work in the cleaning solution avoid allowing the parts to come in contact with the tank, especially if the formation of a red oxide upon the work has been the result of previous immersions. The thin film of oxide or metallic deposits are invariably attributed to a faulty solution, when the usual cause is electrolysis. This proves rather troublesome, especially when two or more metals are cleaned in the same solution, in which case the deposition is effected by galvanic action and the films must be removed by a dip or by scouring.

Pure Water

In a great many plating departments, the only water available is that supplied by the municipality for general purposes. This is more applicable to firms engaged in nickel, brass and copper plating, as silver and gold require distilled water. But for cleaning solutions, the tap water is invariably employed, without regard to the quality, as long as it appears clear to the eye. Water that would not be used in a copper or brass bath is, without hesitation, allowed in the cleaning tank. Experience has convinced us that it pays to use filtered rain water for cleaning solutions and the collection of the water is easily effected and kept convenient, either in a cistern beneath the shop, or in a large tank, where the water may be pumped directly into the plating room. River and lake water often contains quantities of calcium sulphate which renders the water hard and the hardness is not removed by boiling, but sal-soda has the desired effect. Some platers soften such water in this manner before its introduction into the bath. Such practice may seem unnecessary, but demonstrates how cautious a really careful man will be.

If the plater will consider the cleaning treatment more in the nature of a chemical process than a mere washing operation, less trouble would be experienced with cloudy, non-adherent deposits. Take for example plumbers' supplies, large quantities of which are daily given deposits of nickel without scouring. Some of the best men in the business confess that their only difficulty originates in the cleaning bath. The defect may be peeled work or cloudy, spotted surfaces, or some other trouble. The plater tries a change of cleaning compound and for a time the results are really better. Then the old conditions recur, and possibly, in disgust, he resorts to scouring, hoping to soon learn of something new. If the plater will look beyond the cleaning bath and consider the nature of the material used in polishing and which is the substance to be removed from the work, the question usually can be easily answered. If an emery paste composed of tallow, rosin and emery is used, then a simple solution of caustic potash or caustic soda and water, kept at the boiling point, will be effective, but the plater should understand that the treatment has a chemical reaction and the caustic properties of the solution are neutralized and it is rendered slowly weaker. The tallow or other saponifiable fats or oils are likewise neutralized and a form of soap produced. This substance will become quite solid or spongy on the surface of a solution when cold and may be removed easily, after which the bath should be freshened by an addition of caustics. In order to facilitate the cleaning of the bath, the steam coil may be placed on one or both sides of the tank, leaving the bottom free and an outlet controlled by a valve placed about 3 inches from the bottom. The clean solution is drawn off at convenient periods and the dirt removed, after which the clean solution is strengthened by fresh material.

Special Cleaning Preparations

When paraffine compounds are employed in the polishing pastes, ordinary solutions are not so effective and special preparations, obtainable from the supply houses, are recommended. The solution, in any case, must be used boiling hot and kept quite strong. If the precautions regarding the electrical effects, already mentioned, are heeded, the cleaning of all ordinary metals is quite simple. The writer has frequently been required to clean and plate steel pieces to which a worm gear is attached. These gears, having been in use and thickly covered with vaseline, are unfit to approach a plating bath and while the gear is not plated, it must be cleaned to prevent contamination of the plating solution

FIG. 1—TEMPORARY POSITION OF EXHAUST FAN WHICH FURNISHED THE DRAFT FOR A 20-TON OPEN-HEARTH FURNACE

or the surface to be plated. In the preparation of these parts we have never resorted to the use of benzine or other volatile liquids. They are first washed in a strong, hot solution of soda ash to remove the bulk of the grease and are rubbed dry with clean, fine sawdust. Finish the cleaning in a hot solution of caustic soda, 12 ounces; common rosin, ¼ ounce, and rain water, 1 gallon.

Cleaning Steel Work

When steel work is to be copper-plated prior to nickeling, the tendency to indifferently cleanse the steel and to depend upon the cleansing properties of the cyanide copper solution to remove slight films of grease, often results in a contaminated copper solution. The surface of the solution becomes foul with oil globules which appear as gas bubbles or foam. These move toward the sides of the tank where the oil is deposited, film upon film, until eventually a rim of dirty brown grease has collected and remains a constant menace to future attempts of the plater to secure perfect work from the bath. Using the cyanide copper bath as an electric cleaning solution is a practice to be condemned. It is unnecessary and does not encourage skillful work. For case-hardened work we have found a hot potassium cyanide dip very effective for the removal of oxides. It acts rapidly and if kept strong, will prove a handy dip in various emergencies. Such dips are not recommended unless equipped with exhaust hoods to carry off the poisonous fumes which are more noticeable from such dips than from hot copper solutions. The dips should be kept covered when not in use.

For certain work, pickling or sand-blasting is the method used to remove scale, but often the pickling process is unsatisfactory and the sand-blast effect is not always desirable, or the plater receives work with portions polished and a portion covered with scale which he wishes to remove before plating. Such work may be cleaned quickly and thoroughly in a solution of sulphuric acid, 1 gallon; bisulphite of soda, 5 pounds, and water, 4 gallons. This solution should be used at a temperature of from 120 to 150 degrees Fahr., with an anode of carbon at least equal in size to the cathode. A current of 50 to 60 amperes at four or five volts tension, with work 6 to 8 inches from the anode, will suffice to clean scale from all ordinary iron or steel work. The specific gravity of the solution should be maintained at about 28 degrees Baume by the occasional addition of sulphuric acid. If the scale is slight or of a non-metallic nature, a momentary plunge direct from a boiling solution of caustic soda or lye into a 20 per cent solution of sulphuric acid and water will usually effect its removal sufficient to proceed with the deposition of either copper or brass and has the advantage of being harmless to polished surfaces.

Forced Draft for Open-Hearth Furnace

Owing to the destruction of its open-hearth furnace stack, the Ohio Steel Foundry Co., Lima, O., was compelled to operate its 20-ton furnace temporarily by means of mechanical draft. The stack, which was accidentally pulled down, was 115 feet high and 60 inches inside diameter. It was lined to the top with a 4½-inch ring of fire brick and immediately after the accident an 80-inch exhaust fan was ordered from the American Blower Co., Detroit. In two days the open-hearth furnace again was placed in operation, the draft being provided by the exhaust fan. At first this fan was operated at 750 revolutions per minute, but it was found that the draft was excessive and the damper had to be kept almost closed. The speed of the fan was reduced to 500 revolutions per minute and the forced draft was practically the same as that provided by the stack.

In the accompanying illustrations, Fig. 1 shows one end of the foundry and the position of the exhaust fan, while Fig. 2 is a view of the fan as installed. A brick flue, approximately 10 feet high and arched at the top, was built on the stack foundation with an opening at the side for the pipe which leads to the exhaust fan. The fan was driven by a 25-horse-power motor.

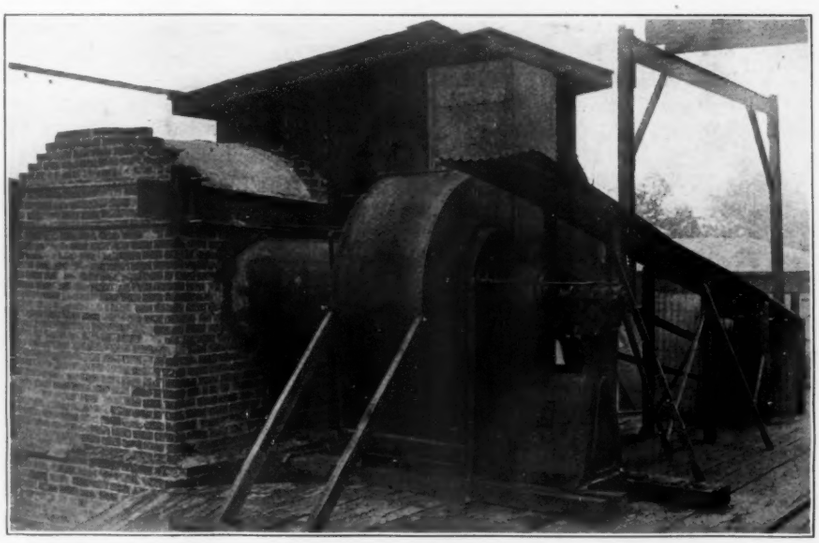


FIG. 2—ANOTHER VIEW OF THE EXHAUST FAN

Making Dies Used in the Die-Casting Process

The Permanent Molds Used for the Production of White Metal Parts—How They Are Designed and Manufactured

THE die-casting or extrusion process of producing white metal parts of which thousands of duplicates are made, is of comparatively recent origin, dating back only about 10 years. This process has been widely adopted and is employed on an extensive scale in the production of cast parts for cameras and automatic photographing machines, for magnetos, motor starting devices, electric lighting systems, speedometers, automatic vending machines, time controlling devices, counting machines, cash registers, water circulating and force-feed oil pumps, carburetors, piano players, roller and ball bearings, gas meters, typewriters, precision instruments of various kinds and for many other purposes. This partial list of castings reflects the wide range of usefulness of the die-casting method.

Briefly, die-castings are made in metal dies instead of in sand. The dies are mounted on a casting machine and into them the metal, under pressure, is forced. The dies are so constructed, that by the operation of levers and ejectors, they open after each cast and the casting is released from the dies automatically. The time required to produce a casting, depends, in large measure, upon the skill of the workmen and also upon the form and size of the casting being made. The output varies from 50 per day for the most complicated castings to 1,500 per day for simple pieces which are cast in a multiple die.

The Die

The die, of course, is the factor of prime importance in the success of this process, this being based almost entirely on the way in which the die is designed and on the accuracy of its dimensions. For the designing of dies, the Doehler Die Casting Co., Court and Ninth streets, Brooklyn, N. Y., maintains a staff of draughtsmen working under the direction of a mechanical engineer who is a specialist in the laying-out and construction of dies for this work. The first step in designing the die for a particular casting is to determine the best position for the mold in the die. There are several positions, as a rule, in which the mold and gate may be cut and one of these is generally to be preferred for reasons which affect the finish and density of the resulting casting. The correct method may involve the least or the most possible labor and expense; since the quality of the casting, however, depends so largely upon the construction of the die, it is the practice of the Doehler company to consider results in preference to cost. Occasionally after a die has been finished, it is found that blow-holes, or other defects occur in the castings. It is then necessary to change the position of the gate or to make such other changes which will result in the elimination of the defects. Figs. 3 and 5 show plans and sectional views of cam ring and magneto front plate dies.

The time required to make a die varies from one week to two or three months, depending on the amount of labor involved. A simple bearing die can be produced at a cost of $50, while a die for an unusually complicated casting frequently entails an expense of more than $1,000. As a rule, high grade machinery steel is used, although some dies are made of cast iron and lined with steel; in some cases, the latter combination proves more satisfactory and is more durable. The process of making a die involves precision machine and hand work, as the dimensions must be accurate within less than one-thousandth of an inch.

All dies are provided with ejector pins which are pushed into the die after the cast, thereby ejecting the casting. These pins are mounted on a plate and penetrate through one side of the die. Oil holes and recesses

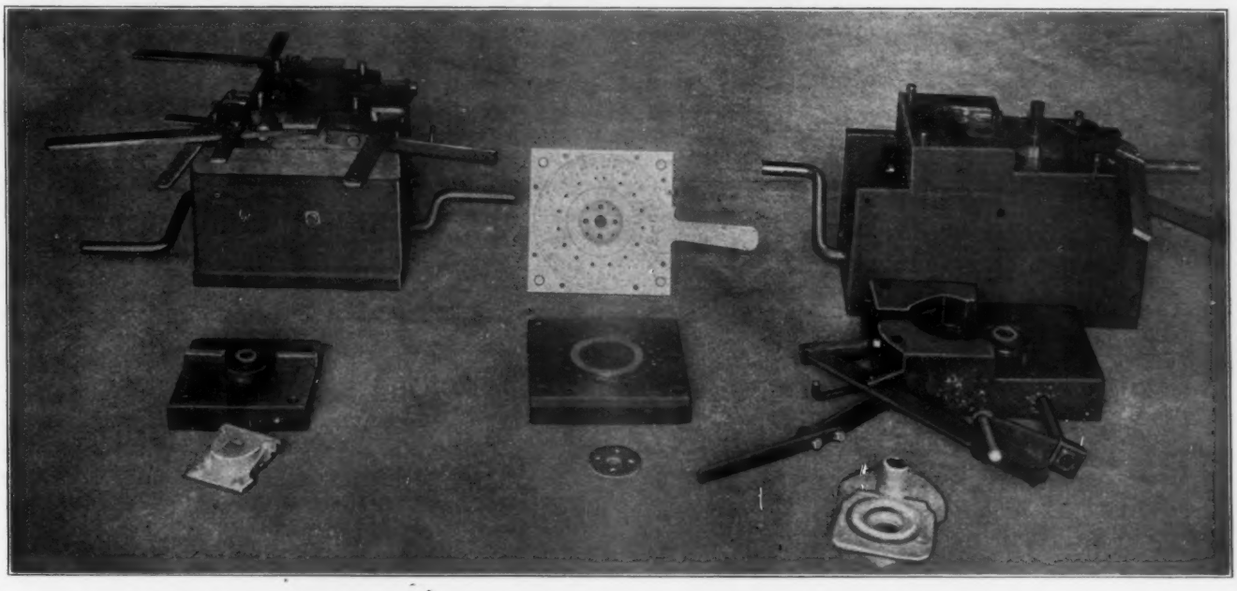


FIG. 1—THREE TYPICAL DIES USED ON DIE-CASTING MACHINES. THE CASTINGS ARE SHOWN IN FRONT OF EACH SET OF DIES

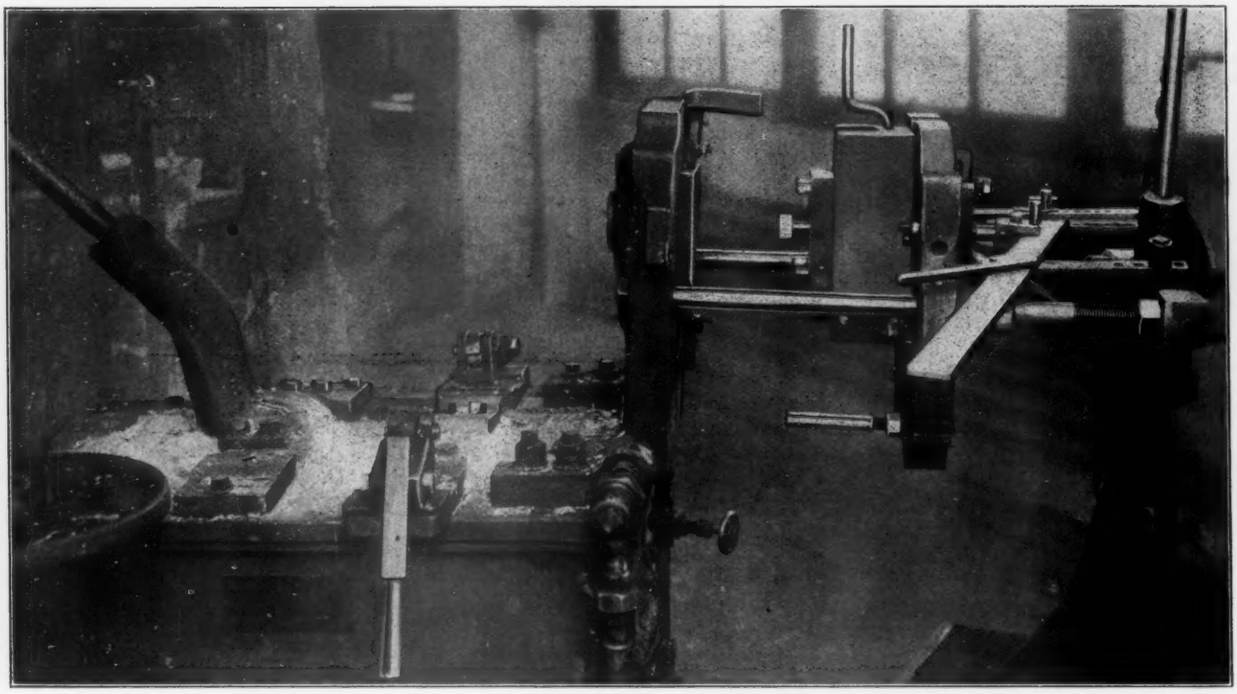


FIG. 2—DIE-CASTING MACHINE, SHOWING THE DIE OPENED AFTER A CAST. THE CASTING IS ABOUT TO BE EJECTED

in castings are made by steel bars or rods and are known as cores. These cores form a part of the die. After the die has been closed and is ready for the cast, these cores are pushed into place, being pulled out again after the cast and before the die is opened for the removal of the casting. Frequently, there are a number of these cores in one die and occasionally one core is designed to pass through a hole in another core. In order that the workman who superintends the operation of the casting machine may not withdraw one core before the other has been pulled out, thus seriously damaging the die, the handles of the cores are provided with catches, and locking and other safety devices, thus rendering the die *fool proof*, as far as possible. These devices also make it impossible for a cast to be made before the cores are placed in position. Sometimes it is desirable to reinforce portions of the die-castings. This is accomplished by making provision in the die for the insertion of steel or brass bushings, plates or pins, which are embodied in each casting. The bushings inserted may be threaded or plain, as desired.

Each die, of necessity, must be vented and this vent is so located that the resulting fins may be cut off without difficulty. In order that the castings may be ejected easily, the mold is provided with a taper or draft. This is very slight, and sometimes does not exceed 0.0005 inch per inch.

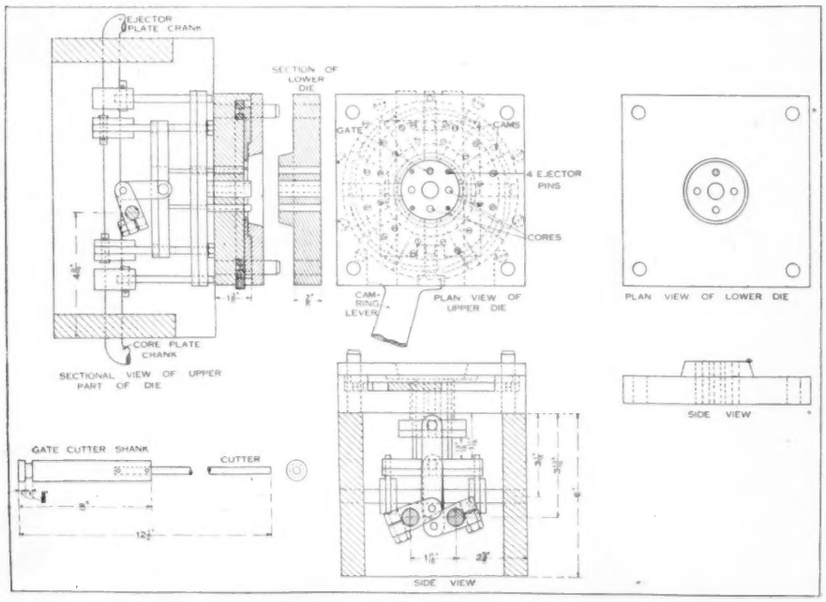


FIG. 3—PLAN AND SECTIONAL VIEWS OF DIE FOR CASTING WHEEL WITH MONTHS OF THE YEAR ON ITS CIRCUMFERENCE

Collapsible Cores

Recesses and undercuts in castings frequently are made by collapsible cores. Thus, when the casting is ejected, a portion of the core of the die also is ejected; this part of the core then is removed from the casting and is returned to its place in the die. Exterior threads may be produced on castings without difficulty, but in order to cast interior threads, the die is not provided with the usual ejector pins; the casting instead, must be unscrewed from the die. When castings are to be provided with inscriptions, the Doehler company prefers to use raised numbers, letters and other characters, since these may be cut into the face of the die at a lower cost than depressed inscriptions.

As to accuracy, the Doehler company can work within limits of plus or minus 0.001 inch on dimensions below one inch; plus or minus 0.0015 inch on dimensions between one and two inches and plus or minus 0.002 inch on dimensions between two and three inches. Owing to the great variety of dimensions and construction, different parts are subject to differ-

FIG. 4—A REPRESENTATIVE ASSORTMENT OF DIE-CASTINGS, SOME OF WHICH HAVE BEEN ASSEMBLED

ent conditions and the company makes the question of accuracy a separate one for each individual case. As absolute accuracy in all dimensions is almost an impossibility, it is customary to devote the most attention to the portions of the die where accuracy is essential, while the other portions are held within reasonable limits.

Representative Dies

In Fig. 1 are shown three representative dies, opened to disclose the mold, while in the foreground are the three castings made in these dies. The cam-ring die in the center is used for solid rings with numbers on the circumference. Since it would be impossible to eject these castings in the usual manner, the number impressions are cut in the ends of steel pins which are moved to and from the center of the die by guides on the pins which are engaged by cams in the cam-ring. Thus, when a casting is to be made, the cam-ring is moved by a lever into the proper position for casting; after the metal has set, the lever is moved in the opposite direction, thus drawing the number pins away from the casting, which is thereupon ejected from the mold. The method of moving the cores by levers is shown by the construction of the dies at the right and left of the cam-ring die, Fig. 1. In the die at the right, the ejector pins are shown in the position they assume when ejecting a casting.

The die-casting machine employed at the Doehler plant is shown in Figs. 2 and 6. It consists of two parts, the lower section being a square cast iron frame supported on four legs and contains the metal reservoirs. The latter is heated by eight gas burners inside the frame, the supply of hot metal being replenished from time to time by ladling it from an auxiliary furnace which is located near the machine. In the basin is suspended a plunger pump, a bottom view of which is shown in Fig. 7. This is supported by a cast iron frame and is immersed in the hot metal. It consists of a cylindrical chamber having a plunger inserted at one end, the latter being forced in and out by a lever. In producing castings, the lever is first raised, thus pulling the plunger out far enough to open the slot at the bottom of the cylinder. The hot metal flows in by gravity and fills the chamber. The lever then is forcibly lowered, squeezing the metal out of the opening at the top of the plunger pump and up into the die.

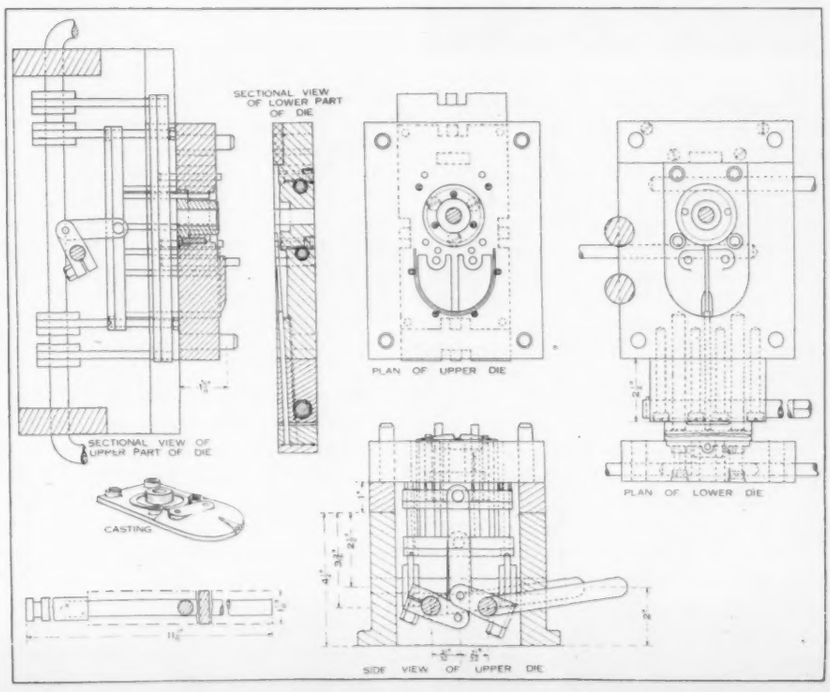

SECTIONAL VIEW OF LOWER PART OF DIE
PLAN OF UPPER DIE
SECTIONAL VIEW OF UPPER PART OF DIE
CASTING
PLAN OF LOWER DIE
SIDE VIEW OF UPPER DIE

FIG. 5—PLAN AND SECTIONAL VIEWS OF DIE FOR MAGNETO FRONT PLATES

This method of forcing the metal into the die has been found satisfactory in effecting the desired density of the metal in the castings.

The carriage of the die-casting machine is shown in a horizontal position in Fig. 2 and in the vertical position in Fig. 6. Fig. 2 is a view of the machine immediately after a cast has been made, and shows the die opened and the casting, a small gear wheel, about to be ejected from the mold. The method of opening the die by sliding its top section along two parallel rods is clearly shown in Fig. 2. The lower part of the die is permanently

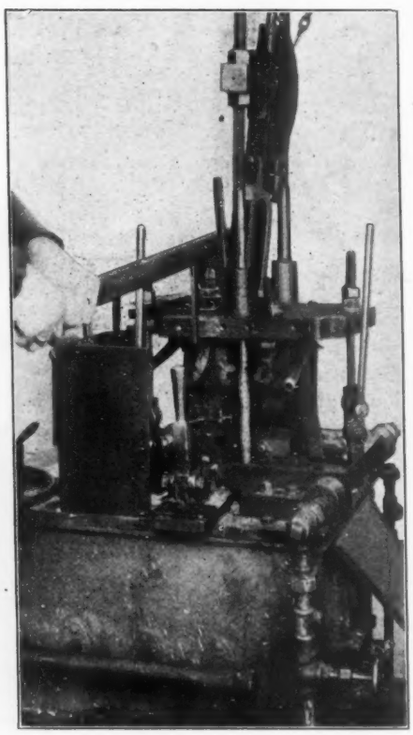


FIG. 6 — CARRIAGE OF DIE-CASTING MACHINE IN POSITION FOR A CAST

attached to the base of the carriage, which, in turn, is attached by a hinge to the frame of the machine. The gate is cut in the lower portion of the die, the hot metal entering through an opening in the base of the carriage. This opening is provided with a cupped socket into which the nozzle of the plunger pump fits when the carriage is brought to the vertical position.

Fig. 6 shows the carriage in the vertical position, the die being closed and the various levers set for casting. The lever in the hands of the operator is the one which controls the gate cutter. After the metal has been forced into the die by bringing down the plunger pump lever, the operator brings down the gate cutter lever, thus cutting off the flow of metal. Great skill is required in this part of the operation, as the density of the casting depends, in a large measure, on the judgment of the operator in closing the gate at the right time.

Operation of the Machine

Each casting machine is provided with a pneumatic hose connection in order that the face of the die may be cleaned with compressed air after each cast. Each machine is operated by three men; one operates the plunger pump and keeps the basin of the machine supplied with hot metal. The foreman directs the operation of the machine, opening and closing the dies, cutting off the hot metal flow, etc. The third man weighs and examines each casting, assists the foreman in operating the core levers, and cleans the plunger pump nozzle and the face of the die.

The inspection of castings at the plant of the Doehler Die Casting Co. is thorough and prevents the shipment of any defective pieces. That each piece may be weighed quickly and accurately, scales are located at the side of each machine; if the weight is correct, the casting is practically homogeneous, while if the weight is not up to the standard, the casting is rejected and thrown back into the melting pot. In the inspection department, the castings are measured, sounded and otherwise inspected. The Doehler company has posted a notice in the plant announcing that the passing of defective castings by any employe will be held as sufficient cause of immediate dismissal.

In most cases, the company can make a die from the drawings submitted by a customer. Frequently, however, the re-designing of the piece becomes a necessity. When it is found that the metal to be used is not sufficiently strong to withstand a given strain or that the margin of safety is too close, the design is changed by adding stock, webs, fillets, bosses, etc. The cost of the die is defrayed by the customer and becomes his property.

Metal Mixtures

The metals used by the Doehler company are alloyed in its foundry. The mixtures frequently consist of zinc, lead and tin with some copper, antimony, etc. The company carries a number of standard white metal alloys which may be used satisfactorily in a wide range of castings. As a number of factors, however, such as high co-efficient of expansion, low fusing points, the affect of steam, gasoline, alkaline or salt waters, corrosion, etc., must be considered, the company prefers to adjust the composition of the metal according to the working conditions to which the casting will be subjected.

The expense of making a die, as compared to the cost of patterns for casting in sand, prohibits the manufacture of parts used only in small quantities by the die-casting process. When a large number of duplicate parts is required, however, the cost of the die is more than absorbed by the cost of manufacture.

The chief advantage of the die-casting process is that it eliminates the machining and finishing of castings; at the same time it enables the manufacturer to eliminate irregularities and inaccuracies in machining, and the human element which tends towards imperfection. The manufacturer receives his parts finished and does not have to maintain machinery, jigs and tools required for machining sand castings. Frequently, an irregu-

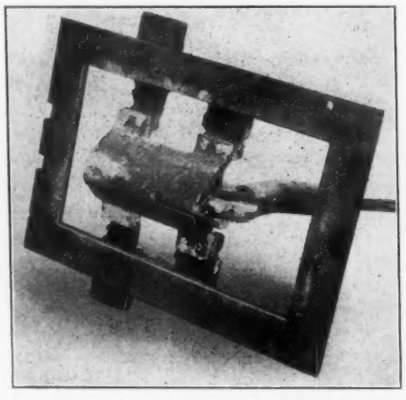


FIG. 7—PLUNGER PUMP OF DIE CASTING MACHINE

larly-shaped part, which has been dissected and sand-cast in several pieces to permit machining, may be redesigned and produced as a unit by the die-casting process. This method of making castings has been especially valuable in making possible the manufacture of articles which by former methods could not be made on a commercial basis because of the prohibitive cost involved. The die will last indefinitely, if kept properly lubricated and will produce many thousands of castings before it loses its usefulness. In Fig. 4 is shown an assortment of castings which are typical of the work produced by the die-casting process.

The Doehler Die Casting Co. has recently extended its process to the production of brass parts under pressure and the manufacture of aluminum die-castings. It also produces a full line of babbitt-lined bronze bearings.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Casting Brass on Steel

Can you advise us how we can cast a yellow brass handle on a steel lever? The end of the steel lever to be covered with the brass is ½ inch wide, ⅛ inch thick and 1½ inches long. The brass handle is to measure ⅜ x ¾ x 3 inches. These handles are polished and, therefore, should be free from defects. We experience considerable trouble from blow-holes.

To successfully cast brass handles on the steel levers mentioned, the latter should be heated and inserted in the molds just before the latter are poured, so that the steel has no opportunity to cool and to condense moisture upon its surface.

High Pressure Valves

We manufacture valves which are subjected to 80 pounds pressure, but we find that the metal is porous and our losses average from 20 to 50 per cent. Our mixture consists of 116 pounds of brazed tubing scrap, which is an alloy of 70 per cent of copper and 30 per cent of spelter; to this we add 2 pounds of lead and 2¾ pounds of zinc. The valves are about ⅛ inch thick. The metal is melted in a tilting, coke-fired furnace and is poured into an intermediate crucible. The metal is constantly covered with charcoal to a depth of 1 or 1½ inches. We have used salt and also glass as a flux. The molds are poured upright.

It is doubtful whether you can reduce your losses so long as you use yellow brass in your valve mixtures. Your alloy is not suitable for making castings that are to be subjected to high pressure, and it is a question whether this is as economical as red brass when the excessive loss is considered. Some improvement might be effected by the substitution of 2 pounds of tin for the 2¾ pounds of zinc.

The Gating Problem

We cast bronze gears from an 88-10-2 mixture, which is melted in an oil-fired crucible furnace. The metal is poured at approximately 2100 degrees Fahr. Frequently after the sprues are cut off, holes develop which extend from 2 to 3 inches into the castings. The sprues are 1½ inches in diameter, and a large feeding head is employed.

If it is possible to pour the gear castings from the bottom, using a horn gate ¾ inch in diameter, you will probably obtain better results, but if for any reason they have to be drop-gated, use a sprue 1 inch in diameter. This sprue should be filleted at its junction with the casting and the mouth should be widened to a funnel shape. Do not drop the metal directly into this drop gate, but cover the latter with a runner box or frame, rammed with sand, and carrying a sprue located about 4 inches away from the drop gate when the frame or runner box is adjusted on the mold. Connection between the drop gate and the sprue is made by a channel cut in top of the mold, which serves the same purpose as a runner. The metal is thus stepped into the drop gate and the sprue can be kept full while pouring. Also the drop gate can be fed by carrying it up into the runner box, at which point it can be made of large section. The extension of the drop gate must not cut through the runner box, as otherwise its value as a feeder will be greatly impaired. Of the two methods, the horn gate is to be preferred, but it should be used in conjunction with a heavy feeder.

Metal Oxidation

We are experiencing considerable trouble with small castings, due to the oxidation of the metal. Our mixture consists of 3 pounds of copper to 1 pound of zinc, and 3 pounds of tin are added to 100 pounds of metal. The metal is melted in an oil-fired furnace and care is exercised to prevent its oxidation. We have tried to make these castings in manganese bronze, but have not been as successful as with the mixture given. It is essential that the castings have a yellow color. They are machined and highly polished.

Place the following flux in the crucible with a cold charge of metal: Black oxide of manganese, 1 pound; charcoal, ½ pound, and salt, 2 ounces. Use one-half of this quantity for a heat of 100 pounds of brass. In the open-flame furnace use 1 per cent and charge with cold metal. The charcoal in the flux will reduce a portion of the manganese oxide to the metallic state, which will act as a deoxidizer. The quantity of manganese that may be reduced largely will depend upon the heat attained in the furnace. When thoroughly deoxidized by the manganese, the brass castings will have a brown color quite pleasing in appearance, and this color can be regulated as desired by varying the amount of flux. Instead of the flux, manganese-copper might be employed in any proportion varying from 0.25 to 1 per cent.

Pouring Leaded Alloys

How should metal be poured which contains a high percentage of lead, also a mixture containing a high percentage of zinc, such as yellow brass? We would like to know whether it should be poured very hot or whether the metal should be stirred continually until the crucible is empty.

It is not necessary to continually stir mixtures containing high percentages of lead or zinc while they are being poured into molds. Yellow brass should not be poured too cool, as otherwise the castings will be defective. The metal should smoke considerably, but it should not be in a state of ebullition. The brass must be poured with decision, the aim being to keep the sprue full, thereby preventing the egress of zinc oxide into the molds which would produce a streaked appearance on the castings. When very high percentages of zinc are introduced, the metal generally will run dirty, the castings appearing as if filled with grains of sand. This trouble may be remedied by the addition of two ounces of aluminum for each 100 pounds of brass. Highly-leaded alloys should be poured cool and the metal may be stirred after each mold is cast.

Aluminum Solder

We have received a sample of metal said to be of English make and which is known as "King Horn" brass. Kindly give us the composition of this alloy. In his book entitled "Brass Founders' Alloys," page 57, Mr. Buchanan gives a composition of brazing solder which contains aluminum and which is to be used for high pressure steam pipes. We are of the opinion that all metals containing aluminum are not recommended for castings subjected even to low pressures, and we should like to know

how a solder containing aluminum could be satisfactory for such use.

The exact composition of the metal to which you refer can only be obtained by careful analysis, but evidently it is a hard-rolled yellow brass. The color is produced by oxidation. While it is known that aluminum will cause castings to leak under pressure, we do not believe it would have the same effect on a solder, as the latter is sweated in a thin layer between two joints of metal and is quickly chilled. Therefore, there is no opportunity for the aluminum to segregate, and oxidation is prevented by the fluxes that are used. If there is any objection to the use of aluminum with hard solder, Mr. Buchanan would have been aware of this fact, and would have omitted it as a constituent of such alloys.

Difficulties With Pump Liners

Recently we cast two pump liners which were exceedingly porous at the bottom end and, in addition, the metal in the defective area was so hard that it could not be machined. When the metal for these liners was melted, one of these pots was ready before the other, and we are of the opinion that this may have had some bearing on the difficulty. When the first casting was made, one pot had to be held 1½ hours until the other was ready, and when making the second casting the first had to be held 45 minutes. In both heats, the metal in each pot consisted of 250 pounds of brass scrap and 50 pounds of heavy scrap copper, to which 3 pounds of zinc and ½ pound of metallic phosphoro were added, the latter having been used as a cleanser. The metal was melted under charcoal and salt was placed in the bottom of each crucible prior to melting. The liners were 30 inches long and 19¼ inches in diameter, the metal thickness having been ¾ inch. The castings were poured upright through two gates, one within 6 inches from the bottom of the casting, while the other carried the metal into the top. The contents of the first pot were poured into the mold through the bottom gate and when the crucible was almost empty, pouring was commenced by the second pot through the top gate.

The method usually pursued in making liners is similar to the one adopted in this case. It might be advisable, however, to carry both gates to the bottom of the casting and to pour both pots simultaneously. In addition to the bottom gate, it also is advisable to cut a top gate from each sprue to feed the casting. The top gate should be heavy and should be of such form that the metal will not enter the mold until it has been almost filled by the metal from the other gates. Below this gate, where it passes through the cheek, the thickness of the sprue should be about 1¼ inches, but above the top gate, where it passes through the cope, the diameter of the sprue should be greatly enlarged, approximately to 3½ inches, to enable it to act efficiently as a feeder.

Every effort should be made to have the two pots ready at the same time, and it might be advisable to start the slower furnace first, approximately 45 minutes before melting begins in the faster furnace. With reference to the mixture, it is advisable to use all scrap brass, omitting the copper, unless it is believed that the alloy is too hard, and if this is the case, we suggest the addition of 3 pounds of lead instead of zinc. It also is advisable to use a deoxidizer and for this purpose 5 pounds of 15 per cent phosphor-copper should be added to each pot as soon as the contents are hot enough to dissolve this addition. Pour both pots at the same time and pour the metal strongly. The metal should be sufficiently high in temperature to appear bright, and to prevent its soaking into the mold, the latter should be protected by a coating of plumbago wash prior to being skin-dried.

The hardness of the metal at the bottom of the castings is due to a difference in the composition of the scrap used in the first pot. The fact that it was held in the fire for a longer period than the second crucible would have no effect on its degree of hardness. The porosity was caused by oxidation resulting from holding the pot in the fire. The metal absorbed oxygen, and every effort should be made to avoid this. If a gun metal, it will not absorb sufficient sulphur from the coke to do any damage, and the porosity produced by this element in bronze is only superficial and easily can be detected before the casting is machined. Underneath this thin, porous skin the metal will be denser than if no sulphur had been absorbed.

Converter Steel Ladle Lining

Question:—We are experiencing considerable difficulty with our bull ladle lining, which is cut badly by the converter steel at the end of every heat.

Answer:—Use the following mixture: Two parts of ground fire brick and 1 part of silica sand; add sufficient fire clay to bind the mixture and line the ladles in the usual way.

R. B. Seidel, Inc., Philadelphia, manufacturer of crucibles, has increased the capacity of its plant by the erection of an addition, which considerably increases the floor area of the works.

How to Use Tube Brass

We have a large accumulation of soft tube brass, and owing to the fact that our castings consist largely of hard-wearing brass, we would like to know how to utilize this scrap. We also are experiencing some trouble in obtaining sound castings, as many of those which we are making draw behind the runner. These consist largely of worm wheels, and are covered with a silvery skin, which would indicate the presence of some foreign metal. Also, we would like a formula for a bronze that will withstand corrosion.

Soft tube brass can be worked in the following manner: For a hard, strong bronze, melt 80 pounds of copper under charcoal, add 10 pounds of tube brass while thoroughly stirring the mixture and follow this with 10 pounds of tin. A fair grade of steam metal can be made by adding 20 pounds of tube brass to 70 pounds of molten copper and by alloying therewith 5 pounds of tin and 5 pounds of lead.

For a good grade of red brass use 64 pounds of copper, 20 pounds of tube brass, 3 pounds of tin and 3 pounds of lead.

Drawing behind the runner can be overcome by using heavier gates, by cutting the runner in both cope and drag of the mold and by pouring the metal hotter.

The silvery skin indicates the presence of aluminum in the bronze. This can be removed entirely by oxidation, but if zinc is present, this metal will interfere with this process and both zinc and aluminum will have to be removed. Oxidation is effected by stirring the copper oxide into the molten metal, and we would suggest that small amounts of metal first be treated until the process has been mastered. As prevention is always better than the cure, the greatest care should be observed to keep the metal aluminum free.

A formula for a non-corrosive bronze follows: Copper, 80 pounds; phosphor tin, 4 pounds; tin, 6 pounds, and lead, 10 pounds.

The Silica Products Co., with offices at 964 Peoples Gas building, Chicago, has recently opened a plant at Twenty-third and South La Salle streets for the manufacture of a new steel foundry facing. The facing is designed to produce clean draws and to eliminate scale from the castings. It is also said to greatly facilitate the removal of cores. The facing is a silica compound, and when in use fuses from contact with the molten metal to a depth of from 1/32 to 3/32-inch.

Making Foundry Tools by Short-Cut Methods--II

Methods of Molding and Casting Back Plates and Various Types of Grids and Lifters for Cores

By Joseph Horner

PLATES of various kinds form a very large proportion of foundry tools. They are used as drawbacks in the loam work, in cores and in molds. These plates are all cast in open sand, since rough surfaces are rather advantageous than otherwise, and thicknesses and dimensions need not be exact. Level beds of sand are the basis for this open sand work, the molds being made either by the strickle or by sweeping boards. The former is employed largely for rectangular shapes, and sweeps for circular plates such as are used extensively in loam work. However, either may be employed for either purpose.

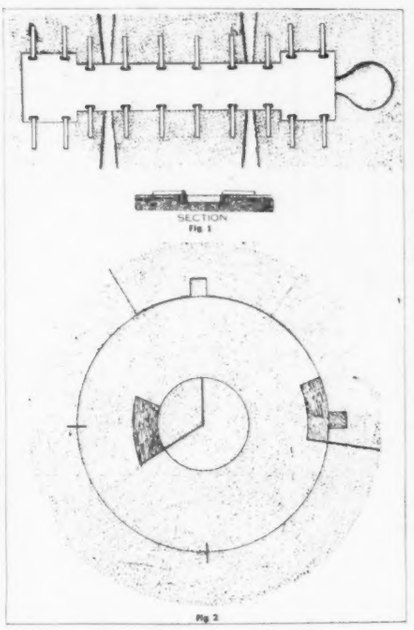
Open Sand Bed

As practically all rough foundry plates are cast in open sand, the bed must be quite level. The mold, when strickling is done, is levelled by winding strips bedded-in, and is tested by a spirit level. The tops of the strips then serve as the guides to the strickle. When swept-up with a bar, the spirit level is laid on the top edge of the sweeping board, which is cut parallel with the bottom edge; or, the top face of the socket is tested and adjusted by the level, and the sweep of the board insures a level bed. The first method is more exact.

After the bed has been levelled the outer edges of the mold are made up with straight or curved strips, or with other sectional pieces, as required. Not only are edges swept, but circles can be struck on the bed as centers for setting by, and distances can be measured off from the edge of the board to the sand face.

Back plates are bolted to the backs of flasks when the latter are of considerable length and have to be poured on end in a pit. The pressure of the metal would be liable to force the sand out at the lower portions of the flask, if it were not confined by these plates. They are molded and cast in open sand and are plain surfaces with the exception of bolt holes which are cast near the edges. The mold is made by first ramming and levelling a bed of sand, using winding strips, bedded-in, as guides. On this bed the dimensions of the plate are marked, and the sides and ends are rammed against the edges of wooden strips, laid down and set by the lines. These strips are from ¼ to ½-inch thicker than the plate, and flow-off gates are cut at the actual thickness. Cores for the bolt holes are laid on the bed by measurement, and are weighted with little bars of iron. A pouring basin is built at one end. Plan and cross-section of a back plate mold are shown in Fig. 1. The cores are weighted, the pouring basin is made and the flow-off channels are cut.

Core rings usually are made either wholly circular or circular in part, having portions which are square to receive steam chests and branches, and



METHODS OF MOLDING BACK PLATE AND CORE PLATE

the slings for handling the core. They are never molded from patterns, but invariably are made on levelled beds by means of sweeps or striking bars. A circular plate or a ring can be swept easily. The edge of the board, which corresponds with the edge of the plate, is bevelled and the edge is later squared against a sweep, Fig. 2. The top edge of the board is made parallel with the bottom or striking edge, to afford a direct check for its horizontal setting with a spirit level. But it is not necessary to strike the edge. The face only need be swept, and on this lines will be struck by which to ram the edges, as indicated in Fig 2.

If a rectangular projecting portion is included at the side of the plate, such as would be required for a steam chest, this is marked out, and its edges are rammed against the edge of a corresponding piece of wood or strips. Lugs are cast on main plates to receive the slings from the cross suspended by the crane. Four equidistant positions are measured off on the circumference, and a pattern lug is laid in and rammed at each point, two being shown in Fig. 2. A central opening similarly can be rammed with a sweep. Such plates usually are covered with prods or gaggers over the whole or a portion of their surfaces, to hold the loam. A section of such a plate is shown in Fig. 9. These gaggers are formed with a pattern containing from eight to a dozen prods which the molder sticks in all over the mold, judging by his eye without any attempt at measurement or regular setting. Fig. 9 shows also prods on the internal edge which are required when a core is lowered within the ring.

Plates which carry central, bricked-up loam cores have lifting eyes cast-in, as shown in Fig. 3. These plates are suspended by rods extending through the eyes. The rods extend through the mold and are supported in various ways. Loam and core plates usually contain numerous holes as shown in Fig. 3. These are formed by pieces of circular cores and aid in venting, also rendering easier the breaking of the plate if this is found necessary.

Drawback Plates

Drawback plates usually are molded on a level bed of sand with little aid from strips. The portion of the pattern against which the plates have to be set is laid on the bed, and the outline and dimensions required are marked from the pattern. Strips, of suitable thickness, are used for outlining the mold. Eyes and rods are cast-in, in the same way as in core plates

and grids. Figs. 5 and 6 are typical examples.

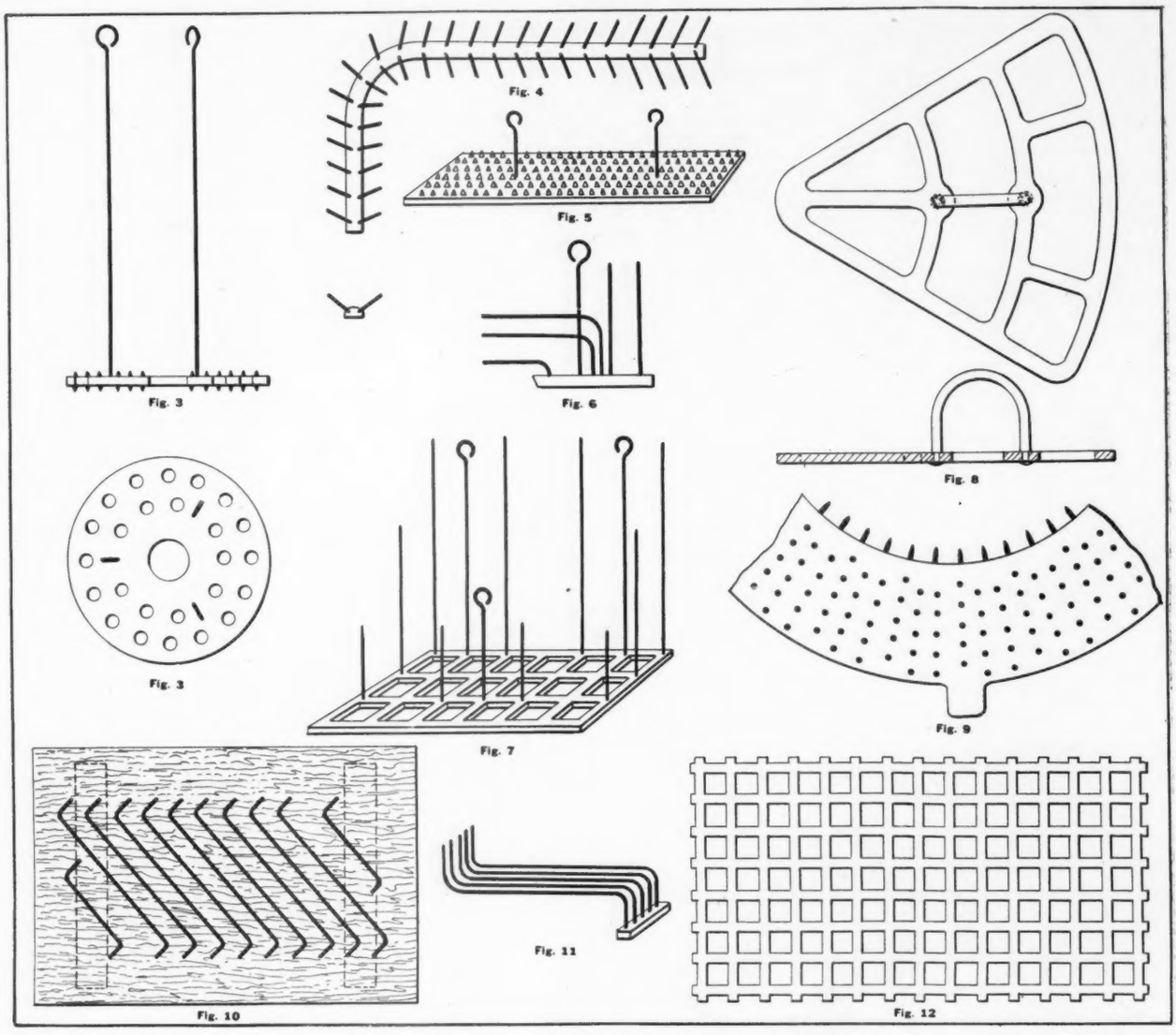
Grids are molded from a standard pattern, Fig. 12, constructed complete in wood, or when of small section, iron patterns may be used. These are stored in the foundry and the molders make grids of various sizes and outlines from them by stopping-off, or by extensions, as the case may be. Eyes are cast-in and are suspended from rods, Fig. 7, in the manner previously outlined. Frequently, these grids are used for cores, long rods, straight, curved or hooked, are cast-in to retain the sand. These are all prepared by the blacksmith, set in the sand and variously supported, until the metal cast around them secures them in place.

Grids similar to Fig. 8, for wheel and pulley arms, usually are molded from a pattern. If necessary, however, a molder will make a grid of rough outline with no help beyond that of the trowel and cleaner. The lifting eye can be fitted and riveted after the casting is made, but frequently it is cast-in. Pipe grids, Fig. 4, are made, as far as the cast portion goes, with trowel and cleaner. The ribs are stuck into the sand, extending sufficiently into the mold to let the metal flow around them.

Fig. 11 is a grid for a steam passage core of large size. Wrought iron rods are bent and cast into the strip which occupies the print impression. The rods are supported on a brick or bricks laid under them at about the center.

Core bars are cast parallel and tapered for pipes and columns. They are pierced with numerous vent holes, the cores for which are put in without measurement, and held with a central nail in each. They are set in the mold before the insertion of the main central core, and the pressure of the latter prevents all risk of their displacement by the rush of metal.

Lifters or S-hooks are molded in quantities on a levelled bed in open sand. Six, eight, or ten patterns, Fig. 10, are nailed to a piece of board stiffened and strengthened with battens on the back and this is beaten down with a mallet into the sand bed until some scores are ready to be cast at one time. No runners need be used, but each lifter is poured directly from a small hand ladle.



DRAWBACK PLATES, CORE PLATES, GRIDS AND LIFTERS

The J. D. Smith Foundry Supply Co., Cleveland, has secured a contract for practically all of the equipment for the new foundry which is being built by the Wilys-Overland Co., Toledo, O. This will include eight core ovens, 10 aluminum furnaces, trolley system and a large amount of small equipment

The Relation of Foundry Floor Space to Output

In the Discussion of This Subject the Area Per Ton of Output of Gray Iron Jobbing, Implement, Steel and Malleable Foundries Was Considered

AT the monthly meeting of the Chicago Foundrymen's Club, held at the Great Northern Hotel, Chicago, April 12, "The Relation of Floor Space to Output" was discussed from various angles. Many figures were presented showing the square feet of molding floor required per ton of output in gray iron, steel and malleable foundries and various ideas as to the arrangement of floor space were advanced. Although few definite conclusions can be drawn from the discussion, the figures presented indicate that in certain classes of American foundries, notably agricultural implement plants and jobbing gray iron shops of from 30 to 60 tons daily capacity, there is a fairly definite economical ratio between output and floor space.

Statement of Committee

The subject was introduced by O. J. Abell, western editor of *The Iron Age*, who read the following statement in behalf of the program committee of which he is chairman:

"The builder of a foundry designs his plant, in the matter of floor area, upon some definite relation between square feet of ground space and tons of castings to be made, about as frequently as the ordinary individual builds a home that entirely satisfies him after it is finished. More often it becomes a case of handling the work to fit the building rather than the reverse. At the same time there is so wide a latitude and such a variety of personal opinions regarding the number of square feet necessary for putting up various classes of work most efficiently, that there is some excuse for not attempting a close restriction of the problem in laying out the foundry. As long as there is room enough, the question of heavier overhead expense, arising out of the cost of property and of buildings, is negligible in comparison with the increase in the continuous operating expense involved in crowding, or inefficient distribution of work over the floor.

"Except where the problem becomes a special one by reason of continuous handling equipment or unusual methods for making duplicate parts, the molding floor area per ton of castings ordinarily increases as the weight of the castings decreases. Conversely, the amount of floor space required for cleaning and chipping increases with the weight of the castings made. The floor space given to the equipment for melting is more dependent upon total output than upon the character and weight of the individual castings.

Gray Iron Shops

"In gray iron foundries, four general divisions may be suggested that will sub-divide castings in general into classes, to each of which some one ratio may be applied with approximate correctness.

"First, foundries for the heaviest machine castings, such as rolling mill engines, fly-wheels, presses, shears, etc.

"Second, foundries for machine tool factories and plants that require average weight castings of simple design; also foundries for average weight castings of more complicated design, such as locomotive, steam engine and woodworking machinery plants.

"Third, foundries for agricultural machinery, textile machinery, printing and paper machinery plants.

"Fourth, foundries for small castings, including light machine parts, machine holding for quantity production, cooking utensils, sanitary ware and soil pipe.

"In this country our advanced methods of standardizing production and the more recent developments of continuous processes result in a much smaller ratio of ground space to tonnage output than prevails in European foundries. The large foundry of a Chicago machinery company, producing heavy castings for the most part, requiries from 43 to 134.5 square feet of molding floor per 100 tons of annual output, the amount depending upon the size and weight of the castings. The foundry of the Nurnberg Works of the Machinenfabrik, Augsburg, Germany, a plant recognized as unusually well-designed and efficiently-operated, requires 323 square feet per 100 tons in the making of a similar class of castings. At the Schenectady, N. Y. plant of the American Locomotive Co., the allotment of floor space per 100 tons of yearly output varies between 172 and 237 square feet. In contrast, the large foundry of the Sachsischen Maschinenfabrik, Chemnitz, Germany, apportions approximately 807 square feet per 100 tons of output annually. Both works are engaged in building locomotives, steam engines and heavy machinery. In that class of foundries where small castings are made, the contrast between American and European practice is still more pronounced. The McCormick plant at Chicago operates its foundry using 262.4 square feet per 100 tons of yearly output, the general average for all of the foundries of the International Harvester Co., being from 258 to

FLOOR SPACE REQUIREMENTS OF VARIOUS FOUNDRIES

Reference letter.	Molding floor dimensions, feet.	Floor area square feet. *a.*	Daily output tons. *b.*	Square feet per ton of daily output. *c.*	Square feet per 100 tons, yearly output. *d.*
		Gray Iron Jobbing Foundries			
A	67 x 80	5,350	5	1,070	360
B	100 x 93	9,300	10	930	310
C	300 x 60	18,000	30	600	200
D	300 x 85	25,500	60	425	141
E	340 x 89	30,200	75	405	135
F	200 x 70	14,000	20	700	234
G[1]	200 x 82	16,400	30	550	183
H	200 x 105	21,000	40	525	175
I	1,000 x 165	165,000	150	1,100	366
J	120 x 40	4,800	8	600	200
W	325 x 58	18,800	35	538	179
		Agricultural Implement Foundries			
K	245 x 124	30,400	55	550	183
L	665 x 150 and 665 x 75	150,000	200	750	250
M	320 x 220	70,400	100	704	235
N	526 x 150	79,000	100	790	264
O	... x ...	49,400	50	988	330
		Open-Hearth Steel Foundries			
P	60 x 240	14,400	30	480	160
Q	275 x 1,000	275,000	175	1,570	523
R	419 x 80	35,500	60	560	187
S	... x ...	61,200	150	407	135
		Malleable Stove Plate Foundries			
T	238 x 85	20,000	15	1,330	443
U	... x ...	35,500	60	590	197
V	190 x 70	13,300	20	665	222

[1]Combined gray iron and steel foundry.

280 square feet. As compared with these figures, similar work, as handled in the foundries of Gebr. Sulzer in Switzerland and Waagner, Biro & Jurz in Vienna, require approximately 646 square feet per 100 tons per year."

Ideal Jobbing Foundry Layout

"In considering ground space requirements," said A. M. Thompson, foundry superintendent, H. W. Caldwell & Son Co., "the question may be more clearly discussed if we leave out the space required for core room and yard for storing flasks, allotting the molder a space on which he can place his molds and his empty flasks. It is impossible to arrange the floor in a jobbing foundry so as to have every available inch covered with a mold, as a place must be reserved to put the flasks when the night men are taking out the castings and tempering the sand.

"The amount of space which may be allotted to a molder will depend largely upon the construction of the building, and should be about 12 x 24 feet to prevent overcrowding. A modern foundry with traveling cranes in the center bay, should have the crane tracks supported by columns 24 feet apart, the center bay 48-foot span, and the sides 24-foot span. From this plan, floors can be arranged 12 x 24 feet and the space in front of each column used for gangways and piling flasks. The accompanying sketches, Figs. 1 and 2, show how this can be arranged and how two floors, Nos. 31 and 32, may be made into one to allow the molding of a 20-foot wheel, without breaking up the general order of the floors. Fig. 1 shows a jobbing foundry floor just before the molders commence to work. The night men have shaken-out the flasks molded and cast the day before, and piled them to the right or left of each floor in front of the columns. The sand has been tempered between these piles of flasks and a clear space left for the molder to work. On some of the floors the work will be a repetition of what was done the day before, as on floors Nos. 1 and 2, 15 and 16, etc., and the same flasks will be used, leaving the sides of each floor at the end of the day entirely clear of unused flasks. Other floors will have changes of jobs, as on No. 3, No. 4, No. 5, etc., necessitating taking off the floor some flasks which were used the day before, and providing other flasks. With this arrangement, no flasks need be taken out during the night, as the flasks on a molder's floor, which are not to be used, are not in the way, and the day labor gang, after bringing to the molder the flask he is to use, may take out during the course of the day, the flasks which are not to be used.

Casting Time

"At casting time, all flasks which are not to be used, have been taken out to the yard, and the gangways are clear of flasks. It would be necessary to produce on these floors an average of 666 pounds of good castings a day, which would figure 288 square feet per 100 tons of annual output, and this space would include the main and side gangways. There are floors for 35 molders and allowing 33 per cent of the heat for gates, etc., the heats would average 35,000 pounds. Floors Nos. 36, 37 and 38 are used for cleaning heavy castings."

Statistics covering 23 modern foundries in the middle west, showing the dimensions of the molding floor, the square feet of molding floor area, the daily output in tons and the square feet of floor space required per ton of daily output and per 100 tons yearly, were presented by H. Cole Estep, associate editor of THE FOUNDRY. The

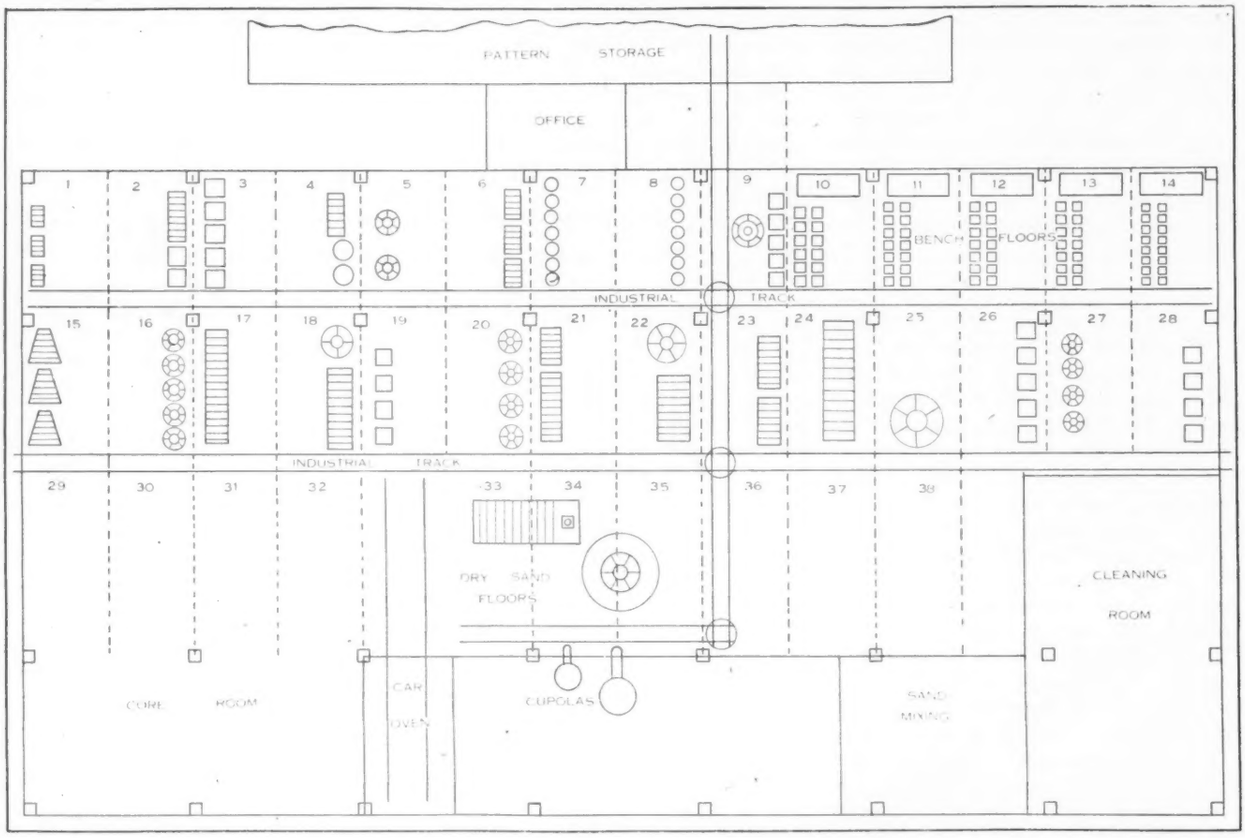


FIG. 1—LAYOUT OF A 96 x 168-FOOT JOBBING FOUNDRY, SHOWING THE ARRANGEMENT OF 38 FLOORS IN THE MORNING BEFORE WORK COMMENCES

detailed figures are given in the accompanying table. The shops were classified into four groups, namely: gray iron jobbing foundries, agricultural implement foundries, open-hearth steel foundries, and malleable stove plate shops. In computing the floor space, the area occupied by cupolas or other melting equipment has been deducted; also no account is taken of the core room area or the space for flask storage or other auxiliary purposes. In other words, only actual molding room area is considered, including of course the space occupied by aisles and gangways. The computations are based on the assumption that the shops operate at their full capacity.

The statistics were originally compiled on a basis of daily output, but for purposes of comparison with other figures presented in this discussion, they have been converted to a basis of floor space per 100 tons yearly output by assuming 300 days' operation at capacity per year. The figures thus obtained are given in Column *D* in the table and were calculated in accordance with the following formula:

$$D = \frac{100a}{300b} = 1/3c \text{ where}$$

D is square feet per 100 tons yearly output.

a is the area of the molding room.
b is the daily output in tons.
c is the square feet of floor space per ton of daily output.

In other words, the figures in column *D* in the table are arrived at simply by dividing those in column *c* by 3.

Gray Iron Foundry Statistics

Referring to the statistics on gray iron foundries, shops A to E, respectively, were designed as a related group of typical modern gray iron foundry layouts by a prominent firm of foundry engineers. It is interesting to note that the floor space requirements decrease progressively with increase in tonnage, ranging from 360 square feet for a 5-ton shop to 135 square feet for one melting 75 tons per day. One of the reasons for this is that a larger shop is generally so managed that it makes more efficient use of its space and also the relative area required for aisles and gangways is much less in a large shop than in a small one. Foundry I, with a daily output of 150 tons, requiring 366 square feet of floor area, is located in the Pittsburgh district and is devoted to the manufacture of heavy mill equipment. The floor area required in shops C, D, E, F, G and H, ranging from 30 to 75 tons daily capacity, is fairly uniform and averages 541 square feet.

There is considerable uniformity in the figures covering agricultural implement shops. Shop K, which is the newest of the five, requires the least floor area, thus reflecting the progress of the day.

In considering the steel foundries, mention should be made of the difficulty in computing the output from data giving only the furnace equipment. The capacities given in the table are based on an assumption of three heats per day in the open-hearth furnaces. In some cases more heats may be obtained, but this will be counteracted by the fact that some of the furnaces must be idle for part of the time for roof repairs and other similar work.

There is a wide variation in the floor space required in the three malleable stove plate foundries listed in the table. This discrepancy, in a measure, may be accounted for by the fact that shop T makes all of its castings by hand on the floor and shops U and V use modern squeezer molder machines and are thus able to turn out a considerable greater tonnage from a more restricted area.

Some of the figures given indicate that the floor space varies directly with

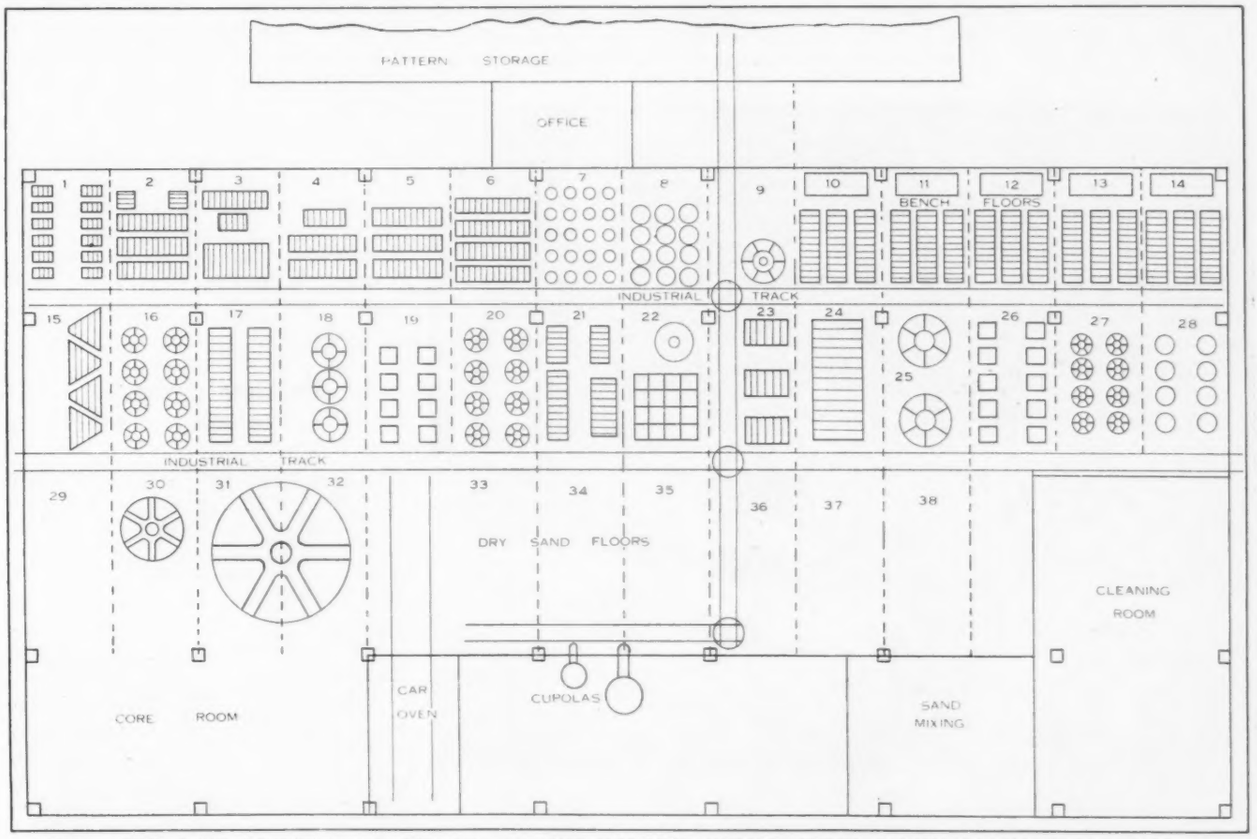


FIG. 2—THE SAME FOUNDRY AT THE END OF THE MOLDING PERIOD, WITH WORK ARRANGED FOR CASTING

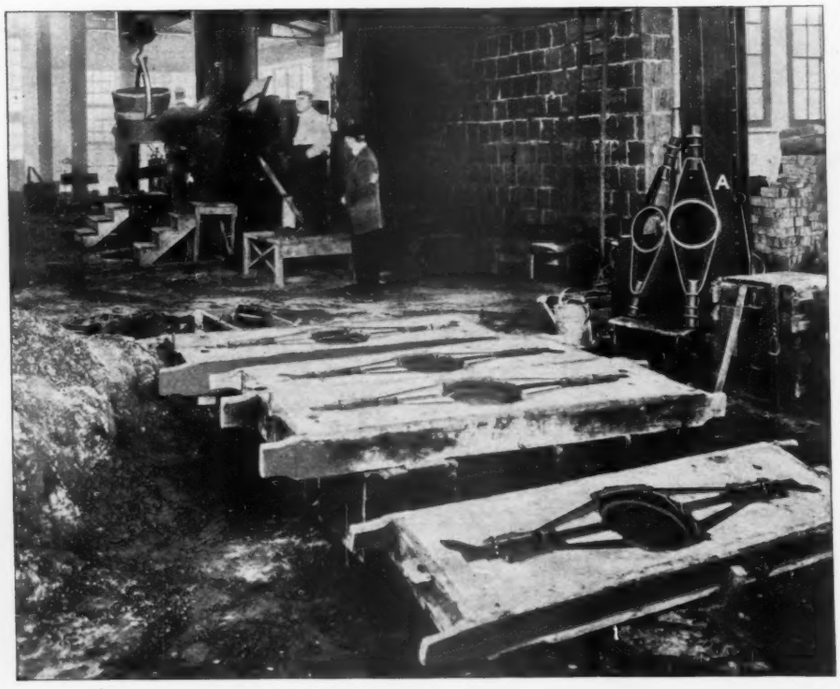
the weight of the castings, rather than inversely as has been claimed in the discussion submitted by the program committee. Shops I, O and Q make heavy machinery castings and require the largest floor area, whereas foundries U and K make very light castings and use but little space. A foundry specializing on heavy jobs may turn out only one casting from a floor in a week, while one handling light work will pour off 200 molds a day from the same space, aggregating often a much greater tonnage than the single large casting.

Eugene Smith, foundry superintendent of the Crane Co., contended that it was impractical to design a foundry by assuming a ratio of floor space to tonnage. He also felt that for jobbing foundry floors, 14 x 24 feet would be better than the 12 x 24-foot floor advocated by Mr. Thompson. "The advantage of a wider floor," Mr. Smith continued, "would be especially apparent for machine molding since at least 14 feet is required to comfortably accommodate two machines placed side by side." The Crane Co. attains a ton of output daily from only 167 square feet of molding room area in some of its foundries. This, however, is due to the continuous molding system employed which effects great economies in floor space. Continuous molding does not save the space required for actually handling the work, but does do away with the large areas necessary for laying-out molds preliminary to pouring in the ordinary foundry.

Casting Steel Axles

Recently the Sivyer Steel Casting Co., Milwaukee, executed an order for a large number of automobile axles which involved some interesting foundry problems in their production. The molds for two of the axles are shown in the accompanying illustration and the finished castings are standing at *A*, against the post in the background. A cope is shown in the immediate foreground with the drag directly back of it.

The casting weighs 61 pounds, is about 5 feet in length and the metal section in most places is not over ¼ inch. The axles were first poured with crucible steel and later with converter metal. The nails shown in the molds are for chilling the few sections which happen to be greater than 5/16 inch thick. Each mold contains a large number of dry sand cores.



DRAG AND COPE HALVES OF MOLDS FOR STEEL AXLES FOR MOTOR CARS

The first attempts to mold the castings were failures, but the chief difficulties were finally solved by the use of a water gate extending through the large center core. This was simply a vertical hole through the middle of the core in which water was poured simultaneously with the molten metal. The water seeping through the porous core chills the casting at this point, thus preventing excessive shrinkage and counteracting the heavy shrinkage pull between the ends of the piece. The water also softens the core so that it does not resist such shrinkage as cannot be prevented, thus avoiding distortion in the casting. The molds are shaken-out the moment the metal is set and the axles are buried flat in sand to keep them from warping. The cores and molds were all dried carefully and the castings poured two up. The molds were made on the floor by hand.

This job was handled in the new converter department which has recently been added to the plant of the Sivyer Steel Casting Co. The new shop, which is 65 x 113 feet, adjoins the old crucible foundry on the east. It is of modern construction with a saw-tooth roof and is so built that it may be readily extended. The equipment includes a 5-ton Pawling & Harnischfeger traveling crane and a 1-ton Tropenas converter and cupola. The converter is shown in the background in the accompanying illustration. Air blast is supplied by No. 2 and No. 3 Roots blowers; the former is connected to a 10-horsepower 220-volt, 3-phase Westinghouse motor and the latter to a 30-horsepower motor. For handling large molding jobs, the foundry is equipped with a 3,000-pound Mumford jar-ramming machine.

Institute of Metals

At the annual meeting of the Institute of Metals recently held at London, Eng., officers for the ensuing year were elected as follows:

President, A. K. Huntington, London.

Vice presidents, G. A. Boeddicker, Birmingham; Prof. H. C. H. Carpenter, Manchester; Summers Hunter, Newcastle-on-Tyne; W. H. Johnson, Manchester, and Vice Admiral H. J. Oram, London.

Treasurer, Prof. T. Turner, Birmingham, and G. Shaw Scott, secretary.

Members of council: L. Archbutt, Derby; Prof. A. Barr, Glasgow; T. A. Bayliss, Kings Norton; G. T. Beilby, Glasgow; Clive Cookson, Newcastle-on-Tyne; R. Kaye Gray, London; George Hughes, Horwich; R. S. Hutton, Sheffield; W. Murray Morrison, London; Arnold Philip, Portsmouth; W. Rosenhain, Teddington; A. E. Seaton, London; W. E. Smith, London; Leonard Summer, Manchester; Cecil H. Wilson, Sheffield; A. Cleghorn, Glasgow.

Under the title of *The Abrasive Age* a new house organ, devoted to the better use of abrasives, is now being published by the Carborundum Co., Niagara Falls, N. Y. The first number, which is standard size and contains 16 pages, is exceedingly attractive and it contains numerous practical articles relating to the use of abrasives.

A New Method of Molding Cast Iron Fire Pots

How the Output of These Castings Was Materially Increased by the Employment of Special Rigging for Making the Mold and Cores

A NEW method of molding cast iron fire pots for steam and hot water heating boilers, which has effected great economies not only in molding, but also in cleaning, has been devised by Abendroth Bros., Port Chester, N. Y. This practice represents a distinct advance over former methods. The output is increased approximately 50 per cent and the castings are of uniform thickness with an almost entire absence of fins. Before this special equipment was constructed, the molds were rammed over a loose pattern in a three-part iron flask and two dry sand cores were employed, which were placed on the drag and extended through the cheek and into the cope.

By the improved method, the cast iron pattern is attached with screws to a heavy, circular cast iron plate, thereby forming a match-plate, and this pattern is never moved from its position on the molding floor. The molder is provided with a number of circular, cast iron bottom plates, depending upon the number of molds to be made on his floor during the day. When beginning his day's task, the molder places these bottom plates on the floor in molding position, and levels them on a sand bed to insure a firm support for the mold.

Dry Sand Core

The first operation consists of ramming a green sand core on each of these plates, employing a cast iron core box, especially built for this purpose. This core box, which is in two parts and which fits over the bottom plate, is illustrated at the right, Fig. 2. At the left is shown the green sand core on the bottom plate. The green sand core contains no arbors or other internal supports and after ramming, the core box is lifted off by an air hoist. Around the green sand core a dry sand jacket core is placed, which is shown at the left, Fig. 3.

The dry sand core is made in a cast iron core box consisting of two sections, the outer being shown at the left, Fig. 4, and the inner section is in the center. The core box assembled and clamped in position for ramming a core is illustrated at the right, Fig. 4. A linseed oil core sand mixture is employed and no arbors or nails are used to support the core. The vents are made by rods, which are inserted through openings in the core box and these are withdrawn after the core has been rammed. After ramming the body of this shell core, a circular plate is clamped to the outer section of the core box for finishing the top of the core. The core remains in the core box while in the core oven and this method of drying has been found to produce excellent results, as the core cannot swell and is of uniform size throughout.

The fire pot mold consists of three parts, namely, the drag, cheek and cope. The drag consists of the dry sand core on the bottom cast iron plate, which is enclosed in the dry sand core, as

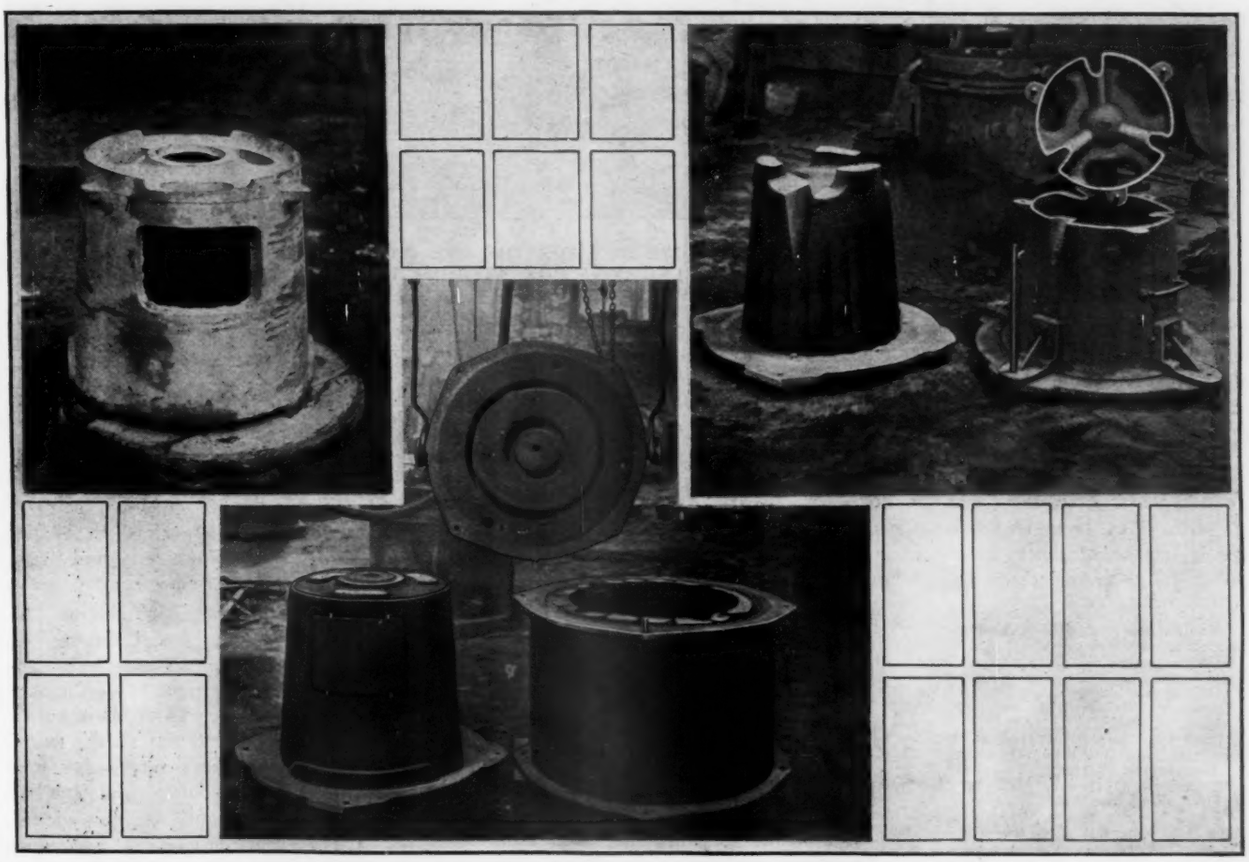


FIG. 1—CAST IRON FIRE POT

FIG. 2—GREEN SAND CORE AND CORE BOX

FIG. 3—THREE PARTS OF FIRE POT MOLD READY TO ASSEMBLE

shown at the left, Fig. 3. The cheek, which is rammed around the pattern in a circular, cast iron flask is shown at the right, Fig. 3, and in this view, the cope part of the mold is suspended from an air hoist. When assembling the mold, the cheek is lifted by hooks on the air hoist and is lowered into position over the assembled core and onto the bottom plate. The cope part of the flask has trunnions on either side, which are engaged by the air hoist for lowering it into position over the cheek. Guide pins and pin holes are provided in the bottom plate and the cheek and cope flasks to insure the accurate centering of the various parts. It will be noted that none of these operations involves rolling over the mold, which greatly facilitates the work of the operator. A casting, immediately after it was shaken-out of the mold and before cleaning, is shown in Fig. 1.

German Foundrymen's Association

The annual meeting of the German Foundrymen's Association will be held at Berlin, May 14 to 17. A large number of interesting papers have been prepared, the program including the following:

"Manufacture of Steel Castings", by Th. Geilenkirchen, Remscheid.

"The Use of Gray Iron Castings in the Construction of Electrical Equipment", by F. Goltze, Berlin.

"Rational Melting in the Foundry", by K. Hunger, Berlin.

"Electrical and Autogenous Welding in Foundries and in other Industrial Plants", by O. Cramer, Berlin.

"Electrically-Operated Molding Machines", by U. Lohse, Stettin.

"Developments in the Briquetting of Metal Chips for Foundry Use," by E. A. Schott, Kassel.

"Modern Coremaking Processes", by J. L. Treuheit, Luttich.

Core Mixture for Steel Castings

Question.—We would like to have a good core mixture for steel castings. It should be sufficiently refractory, as our cores do not peel from our castings satisfactorily.

Answer.—Your difficulty probably is due to the use of an impure silica sand which fuses when exposed to the intense heat of the steel. If the sand is yellow, it contains iron and other impurities, which act as fluxes, causing the sand to fuse to a slag which adheres to the castings with such tenacity that it only can be detached with great difficulty and with considerable expense. The purest silica sand which can be obtained should be used for cores and will be found to be the most economical. A good sand, white in color, should contain 98 per cent silica. This sand frequently is bonded with fire clay and molasses water in varying proportions. For example, the mixture in many successful foundries consists of 10 parts silica and 1 part fire clay, tempered with water containing 1 pint of molasses to 20 pints of water. The clay, however, has a tendency to make the core too strong and it is not burnt out by the steel. Therefore, cores frequently are made of silica sand and the binders frequently employed consist of linseed oil or other oil binders, dextrin, etc. The core should be soft and should have a smooth skin, free from porosity, otherwise, it will be penetrated by the steel. To attain this end, the core may be coated with silica wash while green, and then should be baked until the binder is almost burned out. Such cores will require very careful handling, as the coating of wash holds them together and if this skin is broken, the core is useless.

Another core mixture consists of equal parts of silica sand and silica flour tempered with molasses water and this mixture is thoroughly milled so that it may be toughened and requires no binder.

Thorough milling is essential to the production of a good mixture for cores for steel castings and this will have a tendency to bond the mixture without the aid of a binder, which always is desirable.

FIG. 4—THE OUTER AND INNER SECTIONS OF THE CORE BOX FOR THE DRY SAND FIRE POT CORE ARE SHOWN AT THE LEFT AND IN THE CENTER. THE ASSEMBLED CORE BOX WITHOUT THE COVER PLATE IN POSITION IS SHOWN AT THE RIGHT

Motor Car Bronzes

The American Society of Automobile Engineers has adopted the following specifications for bronzes:

Hard bronze—Copper, 87 to 88 per cent; tin, 0.5 to 10.5 per cent, and zinc, 1.5 to 2.5 per cent.

Gear bronze—Copper, 88 to 89 per cent; tin, 11 to 12 per cent, and phosphorus, 0.15 to 0.30 per cent.

The hard bronze is similar to the United States government bronze *G*, which has a tensile strength of approximately 35,000 pounds per square inch. This is to be considered a general utility bronze for severe working conditions where heavy pressure and high speeds obtain and can be employed for light gears, valves, etc. The gear bronze is commonly known as English gear bronze.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

SPECIFICATIONS FOR EXHAUST SYSTEMS.

Specifications for the design, construction and operation of exhaust systems for grinding, polishing and buffing wheels, which can be advantageously applied by all manufacturers engaged in this work, have been adopted by the New York State Department of Labor. These specifications, prepared by William Newell, mechanical engineer of the department, were issued for the purpose of effecting the efficient removal of dust from grinding and buffing wheels. Their object is to prevent the construction of exhaust systems on faulty designs, such as making the main suction duct too small, and not infrequently, the same size throughout its length; running the branch pipes into the main at right angles and sometimes at the bottom of the main; the use of too small a fan, dust collector, etc. The result of this improper construction is that the suction is entirely inadequate to carry off the dust, which then clogs the ducts and spreads about the room, impairing the health of the workmen.

The specifications follow:

Minimum sizes of branch pipes allowed for different sizes of emery or other grinding wheels:

Diameter of Wheels.	Maximum Grinding Surface, Square Inches.	Minimum Diameter of Branch Pipe, Inches.
6 inches or less, not over 1 inch thick	19	3
7 to 9 inches, inclusive, not over 1½ inches thick	43	3½
10 to 16 inches, inclusive, not over 2 inches thick	101	4
17 to 19 inches, inclusive, not over 3 inches thick	180	4½
20 to 24 inches, inclusive, not over 4 inches thick	302	5
25 to 30 inches, inclusive, not over 5 inches thick	472	6

In case a wheel is thicker than given in the above tabulation, or if a disc instead of a regular wheel is used, it must have a branch pipe no smaller than is called for by its grinding surface.

Minimum sizes of branch pipes allowed for different sizes of buffing, polishing, or rag wheels:

Diameter of Wheels.	Maximum Grinding Surface, Square Inches.	Minimum Diameter of Branch Pipe, Inches.
6 inches or less, not over 1 inch thick	19	3½
7 to 12 inches, inclusive, not over 1½ inches thick	57	4
13 to 16 inches, inclusive, not over 2 inches thick	101	4½
17 to 20 inches, inclusive, not over 3 inches thick	189	5
21 to 24 inches, inclusive, not over 4 inches thick	302	5½
25 to 30 inches, inclusive, not over 5 inches thick	472	6½

Buffing wheels, 6 inches or less in diameter, used for jewelry work may have a 3-inch branch pipe.

The thickness given for buffing wheels applies to the thickness of the wheel at the center. In case the wheel is thicker than given in the above tabulation, it must have a branch pipe no smaller than is called for by its grinding surface.

(*Continued on Data Sheet* 138)

SPECIFICATIONS FOR EXHAUST SYSTEMS.

(*Continued from Data Sheet No. 137*)

Branch pipes must be not less than the sizes specified, throughout their entire length.

All branch pipes must enter the main suction duct at an angle not exceeding 45 degrees and must incline in the direction of the air flow at junction with main.

Branch pipes must not project into main duct.

All laps in piping must be made in the direction of the air flow.

All bends, turns, or elbows, whether in main or branch pipes, must be made with a radius in the throat at least equal to 1½ times the diameter of the pipe on which they are connected.

The inlet of the fan or exhauster shall be at least 20 per cent greater in area than the sum of the areas of all the branch pipes and such increase shall be carried proportionately throughout the entire length of the main suction duct; that is, the area of the main at any point shall be at least 20 per cent greater than the combined areas of the branch pipes entering it between such point and the tail end or dead end of the system. If such increase is made greater than 20 per cent, the area of the main at any point, except that portion of it between the branch entering it nearest the fan and the fan, shall bear approximately the same ratio to the combined areas of the branches preceding that point; that is, between it and the tail end of the system, as the area of the main at the branch nearest the fan bears to the combined areas of all the branches. This provision is made to permit the use of a fan having a larger inlet area than the area of the main at the branch pipe nearest to the fan, is desired.

The area of the discharge pipe from the fan shall be as large or larger than the area of the fan inlet throughout its entire length.

The main trunk lines, both suction and discharge, shall be provided with suitable clean-out doors not over 10 feet apart and the end of the main suction duct shall be blanked off with a removable cap placed on the end.

Sufficient static suction head shall be maintained in each branch pipe within 1 foot of the hood to produce a difference of level of 2 inches of water between the two sides of a U-shaped tube. Test is to be made by placing one end of a rubber tube over a small hole made in pipe, the other end of the tube being connected to one side of U-shaped water gage. Test is to be made with all branch pipes open and unobstructed.

Recommendations

In addition to the foregoing specifications, which are compulsory in the state of New York, the following recommendations are made, which will result in more efficient operation and longer life of the system:

Emery and buffing wheel exhaust systems should be kept separate owing to danger of sparks from the former setting fire to the lint dust from the latter, if both are drawn into the same suction main.

(*To be continued.*)

An Easily-Applied Foundry Cost System---IV

This Article Contains a Detailed Analysis of the Operating Accounts and Describes How the Monthly Cost Report Should be Compiled

By O O Brace

THE analysis of operating accounts, contained in the accompanying tables, will be found adequate for the average jobbing foundry, melting 30 to 40 tons daily. The items can be expanded to show in detail any desired information, or they can be condensed for a smaller shop requiring a smaller amount of detailed information. A suggested system of key numbers also is included and the accountant will find these of prime importance in the economical operation of this cost system. Any desired method of designating the accounts may be followed, but it is essential that some complete system be adopted. All the employes should be instructed to use the numerals in making changes and distribution and any other practice is liable to lead to confusion.

In all discussion of costs, only foundry and core room burden accounts have been mentioned. These two accounts represent the final distribution of all expense charges. For convenience in compiling these expenses it is necessary to set up a third burden account, termed *general burden.*

This burden is really a controlling account for the convenient distribution to foundry and core room, burdens of certain items of general expenditure. For instance, there will be frequently recurring charges for power and heat, office expenses, executive salaries and similar charges, a portion of which is chargeable to foundry burden and a portion to core room burden. It would involve a great deal of work if each of these charges were distributed individually to these two burden accounts, making a great duplication of entries and unnecessary computations. It is much easier to charge the whole of these items into a general burden account and at the end of the month to distribute the total between the two operating accounts in the proper ratio.

Following are the items that should be charged to general burden and the most logical method of determining their redistribution to foundry and core room burdens:

Power.
Repairs to power plant.

The total cost of power produced is to be apportioned on the basis of the respective horsepower actually consumed by each department. Where motors are installed, the amount for each department can be determined readily. Where this form of drive is not used, the accountant will be guided largely by the rated horsepower of the machines in use in each department. Where compressed air is used the relative size and number of taps in regular use will give a sufficiently accurate basis of division.

In the only items to be charged into general burden are, charges for power, miscellaneous supplies and the foreman's time when not chargeable to any job directly. Of course, all pattern-makers' wages, and lumber and metal used, will be charged to the individual jobs. There are a number of small supplies such as glue, fillet, wax, nails, etc., of which an accurate record cannot be kept. These items then are charged to general burden, and are apportioned at the end of the month, according to the amount of work that has been done in the pattern shop, for outside customers, the foundry, and the core room. Other items, including the general burden, follow:

General shop expense.
Interest.
Taxes.
Insurance.
Depreciation.

All charges to those accounts are first made to general burden. No hard and fast rule can be made for apportioning them, but the most satisfactory method is to distribute these charges on the number of square feet of floor space occupied by each department. Should local conditions make this apportionment unfair, any equitable method can be applied. Other general burden items include:

Executive salaries.
Office expense.
Shop superintendence.

These items usually should be distributed according to the number of employes in each department. Instances will occur, however, where special conditions or work habitually demand an unusual amount of supervision in some special department. When this is the case allowance must be made in the apportionment.

After the general burden account has been apportioned, the entries are closed for the determination of the profit or loss on the month's operations.

It is important to compile a complete list of the closing entries required and to work to this list until the routine has been mastered.

MONTHLY COST REPORT

MONTH August 191X

METAL USED	POUNDS	PRICE NET TON	VALUE	COST PER CWT. COST
#1 — Pig	110,000	$17.00	$935.00	
#2 — "	770,000	12.50	4812.50	
#3 — "	175,000	17.00	1487.50	
Steel Scrap	260,000	11.00	1430.00	
Cast Scrap	460,000	10.00	2300.00	
GROSS MELT	1817000		$10668.50	.59
SCRAP SALVAGED — WEIGHT POUNDS / PRICE NET TON / VALUE				
A. GATES AND SPRUES	461,796	10.00	2306.48	
B. DEFECTIVE CASTINGS (FOUNDRY)	300,000	"	1500.00	
C. DEFECTIVE CASTINGS FROM CUSTOMERS	35,000	"	175.00	
TOTAL SALVAGE	796,796	3631.48	796,796	$3631.48
NET PRODUCTION AND COST OF METAL			1036,704	$7037.02 .65
TOTAL MOLDING COST				$1149.50 .75
TOTAL COREMAKING COST				$2011.00 .185
TOTAL DIRECT COSTS				$10197.67
TOTAL BURDEN DISTRIBUTED ON TONNAGE OF GOOD CASTINGS			$4347.80	.40
TOTAL BURDEN DISTRIBUTED AS PERCENT OF MOLDING COST			1750.00	100%
TOTAL BURDEN DISTRIBUTED AS PERCENT OF COREMAKING COST			2614.30	130%
TOTAL INDIRECT COSTS				$8711.80
TOTAL COST OF PRODUCTION				$18909.47
TOTAL VALUE OF PRODUCTION				$19660.00
NET PROFIT ✓ OR LOSS				$750.53
ADD 3567.75 BALANCE FORWARD FROM LAST MONTH			TOTAL TO DATE	$4317.53

FIG. 1—MONTHLY COST OF PRODUCTION REPORT

Prior to closing, each stores' account should be checked to see that it has been credited through the journal and the proper burden or manufacturing account charged for the material used during the month. These are the items most easily overlooked and special care should be taken to insure the proper charges for the stores used.

The following accounts should be closed into the debit side of the foundry *manufacturing account*:

Metals used from foundry stores.
Coremaking account.
Molding account.
Core room burden account.
Foundry burden account.

To the credit of the manufacturing account should be posted the value of the net foundry output, obtained as follows:

From the foundry sales plus the castings on hand as inventoried at the end of the month, deduct the castings on hand as inventoried the preceding month plus the castings credited to customers as defective. The difference will give the net monthly production of good castings.

All of the necessary information is now at hand for compiling a detailed report of the month's operations, showing the net profit or loss on each class of work in the foundry, and also the proper data to be used in figuring the cost of each order if this is desired. A monthly cost report, showing the various items and entries, is illustrated in Fig. 1.

When it is desired to figure individual order costs, it is only necessary to take the cards with the shipping, molding and coremaking records, and to deduct from the record of shipments such defective castings as have been returned, as shown by the defective castings register. If complete records of defective castings have not been received, an estimate based on previous records of similar orders will be useful, although it is only an estimated cost and should be corrected when all the returns are at hand. After computing the cost of the metal, add the molding and coremaking costs and the percentages for the three burden charges, as shown by the monthly report.

You now have complete information on every order and can determine those which are paying a profit and those requiring immediate attention to secure either lower shop costs, or a higher selling price. You need not, as foundries have often done in the past, and are still doing, realize a large profit on desirable work, which is lost on less desirable orders.

Every foundryman desires a busy shop, but he will find that he can realize a greater profit on a small volume of carefully selected business than on a large tonnage which includes jobs netting heavy losses.

Burden Reports

All direct costs, including molding, coremaking and metal, are more or less under the constant supervision of the manager and superintendent. They cannot vary greatly without the fact becoming known. But with indirect and invisible costs, this is not the case. These items have a constant tendency to increase out of proportion with the increase in the volume of business, and when business is suddenly depressed, the very elusiveness of these items and the fact that exact figures are not at hand, renders it impossible for a manager to eliminate the waste expense as rapidly and directly as his business demands that he should.

To furnish this information, a burden report should be compiled monthly, which should show, in comparative columns and for the year, if possible, the exact amount of each item of burden cost, both as a total and as a percentage or comparative unit. Labor should be shown separately from materials. From this report the plant manager can see exactly where decreased expenses are necessary and possible to maintain uniform costs and profits. He can do this accurately and with assurance when the necessary information is at hand to point out the weak spots.

A multi-column journal, large enough for a year's records, is satisfactory for this report. It should be provided with leaves cut alternately at the top and bottom, for convenience in forwarding totals.

DETAILED COST REPORT

MONTH_____ 191__

CLASS	NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO. 6	NO. 7	NO. 8	NO. 9	TOTALS
WEIGHT – GOOD CASTINGS										
COST – IRON – CWT.										
COST – MOLDING										
COST – COREMAKING										
TOTAL – DIRECT COST										
BURDEN – CWT. ON TONNAGE										
BURDEN – PERCENT ON MOLDING										
BURDEN – PERCENT ON COREMAKING										
TOTAL COST										
TOTAL VALUE										
PROFIT OR										
LOSS										
COST PER CWT.										
SELLING PRICE PER CWT.										

FIG. 2—DETAILED COST SHEET FOR NINE CLASSES OF CASTINGS, GIVING DETAILED PROFIT AND LOSS ON EACH

A multi-column journal, large enough for a year's records, is satisfactory for this report. It should be provided with leaves cut alternately at the top and bottom, for convenience in forwarding totals.

Constant Reader

The foundryman who recently submitted a series of questions on gray iron cylinder castings should forward his name and address to THE FOUNDRY, as some additional information is required before his questions can be answered satisfactorily.

Cupolas With Two Rows of Tuyeres

By W. J. Keep

Question:—We would like to know whether any advantages are to be derived from the use of two sets of cupola tuyeres. Will they enable us to make larger heats than when employing only the lower tuyeres?

Answer:—For long heats in large cupolas, two rows of tuyeres can be used satisfactorily, but as the coke bed must extend 15 inches above the upper tuyeres, both at the beginning and at the end of the heat, it will take more coke than when only one row of tuyeres is used. However, if you can shut off the upper row of tuyeres at the beginning and at the end of the heat and only use it when the cupola is very hot, you can melt faster than with only one row. In this case, the coke must extend only 20 inches above the lower row. If you use two rows of tuyeres, both generally are left open throughout the melting operation and toward the end of the heat when the iron gets low, the air from the upper row blows over the iron and chills it. In a cupola of the size which you operate, two rows are not necessary. It is advisable to install a cupola much larger than your present needs and this can be lined down to any size required. When larger heats are necessary, the thickness of the lining can be reduced and the diameter of your cupola will be increased proportionately.

Annual Convention of British Foundrymen's Association

Final arrangements for the annual convention of the British Foundrymen's Association were made at a recent meeting of the council of this organization, held in Birmingham, Eng. An important departure will be made this year in holding the convention two months earlier than heretofore, the object being to avoid interfering with the August bank holiday, which latterly has been found an increasingly inconvenient date for the meeting. The convention will be held in London from Saturday, June 21, to Tuesday, June 24. A strong local committee has been organized, which consists of the leading manufacturers connected with the iron industry in the London district. On the first day of the convention a visit will be paid to the Chemical Industry and Engineering Exhibition and the members will be entertained at luncheon by the organizers of this exposition. On Wednesday, a trip will be made, by steamer, on the Thames river. Monday and Tuesday will be devoted to the reading and discussion of papers and on Monday evening the members and visitors will attend a dinner at the Holborn restaurant.

Among the papers to be presented are the following:

"Semi-Steel", by N. Riddell, Falkirk.
"The Artistic Treatment of Cast Iron", by B. J. Fletcher, Leicester.
"The Alloying of Aluminum," by C. H. Ivenson, London.
"Small Castings", by W. G. Hatfield, Sheffield.
"Air Volume Changes in the Cupola", by F. J. Cook, Birmingham.
"The Economics of Industry and Education", by A. Hayes, London.

Arrangements have been made to visit a number of plants in London and immediate vicinity.

Detailed Analysis of Operating Accounts

A.—Foundry Stores.
1.—Pig iron.
2.—Steel.
3.—Scrap iron.
4.—Coke.
5.—Coal
6.—Molding sand.
B.—Core Room Stores.
1.—Core sand.
2.—Coke.
3.—Wire.
4.—Core oil.
C.—General Burden.
C1.—Power.
a.—labor.
b.—fuel
c.—supplies.
C2.—Repairs to power plant.
a.—labor.
b.—supplies.
C3.—General shop expense.
a.—labor.
b.—supplies.
C4.—Executive salaries.
C5.—Office expense.
a.—salaries.
b.—supplies.
C6.—Shop superintendence.
C7.—Pattern expense.
a.—labor.
b.—supplies.
C8.—Interest.
C9.—Taxes.
C10.—Insurance.
C11.—Depreciation.

Foundry Burden.

BURDEN DISTRIBUTED ON THE BASIS OF TONNAGE.

D1.—Transportation.
a.—cartage.
b.—freight on casting shipments only.
D2.—Night crew.
a.—labor.
b.—supplies.
D3.—Yard labor.
a.—labor.
b.—supplies.
D4.—Cupola cost.
a.—labor.
b.—power.
c.—fuel and supplies.
d.—repairs to cupola equipment.
D5.—Flasks and boards.
a.—labor.
b.—supplies.
D6.—Cleaning and chipping.
a.—labor.
b.—supplies.

FOUNDRY BURDEN DISTRIBUTED AS A PERCENTAGE OF DIRECT LABOR.

D7.—Power account (from general burden.)
D8.—General shop expense.
a.—labor.
b.—supplies.
c.—per cent of general burden.
D9.—Repairs to general burden.
D10.—Repairs to power-driven equipment.
a.—machinery.
b.—electrical equipment.
D11.—Repairs to buildings.
a.—labor.
b.—supplies.
D12.—Repairs to general shop equipment.
a.—labor.
b.—supplies.
D13.—Superintendence.
a.—labor (foremen, etc.)
b.—per cent of general burden.
D14.—Office expense.
a.—foundry clerical, if any.
b.—per cent of general burden.
D15.—Molding supplies.
a.—sand.
b.—all other supplies.
D16.—Executive salaries, per cent of general burden.
D17.—Interest, per cent of general burden.
D18.—Taxes, per cent of general burden.
D19.—Insurance, per cent of general burden.
D20.—Depreciation, per cent of general burden.
D21.—Pattern expense.
a.—labor.
b.—supplies.
c.—per cent of general burden.

CORE ROOM BURDEN.

E1.—Power, per cent of general burden.
E2.—General shop expense.
a.—labor.
b.—supplies.
c.—per cent of general burden.
E3.—Repairs to power plant, per cent of general burden.
E4.—Repairs to power-driven equipment.
a.—machinery.
b.—electrical equipment.
E5.—Repairs to power plant, per cent of general burden.
E6.—Repairs to general shop equipment.
a.—labor.
b.—supplies.
E7.—Shop superintendence.
a.—foremen.
b.—per cent of general burden.
E8.—Office expense.
a.—core room clerk.
b.—per cent of general burden.
E9.—Core ovens.
a.—labor.
b.—fuel.
c.—repairs and supplies.
E10.—Executive salaries, per cent of general burden.
E11.—Interest, per cent of general burden.
E12.—Taxes, per cent of general burden.
E13.—Insurance, per cent of general burden.
E14.—Depreciation, per cent of general burden.
E15.—Core box repairs and expense.
a.—labor.
b.—supplies.
c.—per cent of pattern account, general burden.

The Oscar Schlegel Mfg. Co., 111 East Twelfth street, New York City, manufactures a line of specialties for pattern shop use, including shellac, shellac thinner, light blonde gum orange shellac, German black pattern extract, German pattern glue and rubber-bound glue and shellac brushes. In the circular recently issued by this company, this line of specialties is described in detail and suggestions and instruction are included for the use of these products.

THE FOUNDRY

A monthly journal devoted to all branches of the foundry trade.

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Trade Outloo

CONTINUED activity characterizes all branches of the foundry industry. The malleable shops are crowded for deliveries and the tonnage booked will insure capacity operations until the end of the year. In the New England states the gray iron shops report a slight decline in orders, but throughout the central west, plants are operating in full with shipments deferred from 60 to 90 days. Brass and aluminum foundries are busily engaged in meeting the requirements of the automobile builders, while steel casting producers are unable to meet the needs of the railroads. The floods in central and southern Ohio and western Pennsylvania put a large number of foundries out of commission for periods varying from ten days to two weeks. The casting plants at Hamilton, O., suffered severe losses, many of the shops having been completely wrecked. The losses sustained by these foundrymen are enormous and the period of rehabilitation will be spread over many months. More than 50 blast furnaces also were idle for an average of about one week and the loss in output is estimated at 200,000 tons. Considering the present enormous melt, it was generally assumed that this curtailment of tonnage would have a strengthening affect on the market, but the reverse condition prevails. Orders for large tonnages have been placed recently, but prices were shaded from 50 cents to $1 a ton. It is evident that the merchant furnace output is still considerably in excess of the capacity of the iron and steel foundries, although at the present rate of new foundry construction this period of readjustment will soon end. In the leading centers, foundry grades of pig iron are quoted as follows: No. 2, $16.15 to $16.40, Pittsburgh; northern, $17, Chicago; $16.25 to $16.50, Cleveland; southern Ohio, $16.20 to $16.70. Cincinnati; $17 to $17.25, Philadelphia; $16.50 to $16.75, New York, and $12.25 to $12.50, Birmingham. Malleable Bessemer, $15.25 to $15.50, Pittsburgh, and $16.25 to $16.50, Chicago. Basic, $16.65 to $16.90, Pittsburgh; southern, $17.85, Chicago, and $16.50, Philadelphia; Lake Superior charcoal, $18 to $19, Chicago.

Last year the world's largest corporation, namely the United States Steel, engaged an average of 221,025 employes, compared with 196,888 in 1911. The annual salaries and wages increased from $161,419,031 in 1911 to $189,351,602 in 1912. The gross sales of the Corporation reached the enormous total of $494,637,808, against $399,940,256 the previous year, an increase of $94,697,552.

It's a Great Game

UNUSUAL as it may seem, we have been requested to invest our paltry savings in 7 per cent cumulative preferred stock of a new company that will engage in the mining and shipping of molding sand, the manufacture of foundry supplies and the production of "light iron, steel, brass, bronze and aluminum castings, holding real estate sufficient for the development of this branch of the enterprise". How the real estate holdings will effect the growth in casting tonnage, must be accepted without comment, as it is not our intent to question the pro-

moters' statements. It is claimed also "that the production of molding sand can be safely placed at not less than 125,000 tons per annum, at a net profit of 12 cents per ton". It's a sure-thing proposition, as "the profits will easily run to 12 per cent net over all fixed charges and overhead expenses, including the 7 per cent dividend on the preferred stock". The market for the company's output is described as follows:

> The demand for molding sand is increasing very rapidly, because of the introduction into foundries of machinery and the employment of inferior labor, from the inability of the foundrymen to obtain properly skilled mechanics. New foundries are being built very rapidly and are being so constructed that machinery is fast taking the place of hand labor, making it absolutely compulsory that the twentieth century foundryman purchase larger amounts of foundry sand. Molding machines require the sand to be renewed oftener than the hand workman, for the machines cannot secure the molds properly with gaggers or soldiers as may be done by the skilled molder.

These side lights on the foundry industry will explain many of the cross-currents of recent trade developments that have perplexed casting manufacturers. The constantly increasing use of molding machines should prove gratifying to the shippers of molding sand, if not to the foundrymen and the hand workman undoubtedly will be glad to learn that he does not require renewal as often as the sand for making molds by machine. But this is not all; to round out its product the company will engage in the manufacture of mill machinery, as the following clause will explain:

> The sale of mill machinery is also to be a branch of the business. We have over 1,200 flour mills from which to draw custom in the territory over which we shall have absolute control. The profits on this branch are large, while the investment is extremely small.

Brass foundrymen, who heretofore refused to divulge the secret of their easy profits, will have to look to the promoters of this enterprise for redress. That success in non-ferrous manufacture can be had for the asking is shown by the following:

> The growing demand for brass and bronze castings in the auto, motor and traction car lines is very great, and we feel confident that this branch of the business is almost absolutely successful certainty from the start.

The projectors of this scheme, however, are entirely too modest. They admit that a portion of the preferred stock is offered for the benefit of the treasury, whereas we believed that the promoters would share in the entire proceeds. This is the only weak link in the undertaking, as we cannot understand why these gentlemen, who have taken us so thoroughly into their confidence, should display any interest in swelling the company's bank balance. This is contrary to the laws of high finance and for this reason we refuse to invest.

A material reduction in the duty on aluminum is provided by the tariff measure now before congress. Under the prevailing law, ingot aluminum, scrap and other crude forms of this white metal are taxed 7 cents a pound and plates, sheets, bars and rods, 11 cents a pound. Under the Payne tariff this was equivalent to 47.56 and 56.41 per cent ad valorem in 1910 to 1912, respectively. The new schedule provides for an ad valorem duty of 25 per cent, which is equivalent to 3 cents per pound based on the unit value of imported aluminum in 1912, which was 12 cents per pound. Last year's imports aggregated 14,971,290 pounds, valued at $1,857,726, and the duty collected totalled $1,047,990.

Give'er Air

SLOW iron was the only perplexing problem that helped to wrinkle the brow of the superintendent of the City Foundry Co. Orders were plentiful at fair prices and losses were low. The supply of skilled labor was adequate, although a feeling of unrest was becoming more manifest every day, and was fast reaching the breaking point, as the molders were compelled to spend four or five hours to pour off their floors. Every angle of the melting problem was being investigated; the coke charges were being increased and decreased and the affect of charging the iron in small quantities was tried, but to no avail—the iron would not come down. The fan, which was located in an enclosed room at some distance from the cupola was carefully inspected and was stamped O. K. The blast pipes were without sharp angles and the tuyere area of the cupola was sufficiently large for a furnace of this size. For days, every operation on the charging platform was carefully supervised, yet the mystery of the slow iron remained unsolved. The feeling of unrest among the molders was growing and a strike was threatened unless their demands for a pouring gang were granted. One afternoon a neighboring foundryman wandered into the shop while the heat was on and the superintendent poured out his tale of woe. It was a doleful story that was passed to this attentive listener. He could suggest nothing beyond what had been tried and he sympathized with the molders who were anxiously coaxing the lazy stream of iron into their hand ladles. From the cupola he turned toward the fan room, and after several unsuccessful efforts to enter he asked one of these laborers to unlock the door. The latter informed the neighboring foundryman that the door was latched, but he, too, was unable to force an entry until he obtained the aid of a bar. The fan seemed to be operating satisfactorily and under normal conditions: After a 10-minute inspection the foundryman was about to leave the fan room when the superintendent breathlessly rushed up and asked him what he had done to make the cupola melt faster. "Nothing," was the reply, "I haven't even given the fan a drop of oil." The mystery was not solved after all, yet the desired effect had been obtained. From the fan the two walked back to the cupola and the laborer carefully closed the door to the room to exclude the dust. The stream of iron from the spout grew smaller and smaller and the same old melting condition again prevailed. Mystified, the superintendent rushed back to the fan room, pried open the door and entered. The fan was driving merrily and the iron came faster again. The jinx was in the fan. The door was left open while the superintendent lay in wait for the spirit that was playing these uncanny pranks. The heat was off in record time. The trouble was located at last. The neighboring foundryman examined the room to find an opening for air. There was none when the door was closed. The fan had been driving against a vacuum in its efforts to supply the cupola with air. This solved the mystery of the apparently locked door and slow iron. "Give her air", was the slogan thereafter, and a window cut into the outside wall of the fan room, which was opened when the blast was on enabled the molders to enjoy their evening meals with their families at the usual hour.

Core Oil Storage

The storage of core oil in foundries receives little attention and as a result, a large amount of oil is wasted. When core oil is manufactured, great care is exercised to keep it pure and sweet; however, when air comes in contact with it, it soon becomes rancid and is unfit for use. When decomposition sets in, the very object for which the oil is to be employed is defeated. The essential property of linseed oil is its power of penetration and when it is permitted to remain in a wooden barrel any great length of time, it loses this quality.

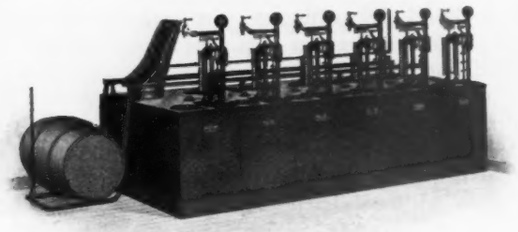

FIG. 1—A BATTERY OF CORE OIL STORAGE TANKS, SHOWING CRADLE FOR ELEVATING A BARREL FOR DISCHARGING ITS CONTENTS

The present practice of permitting core oil to remain in wooden barrels until they are empty is wasteful, as the wood dries out, the staves contract and seepage occurs. In addition, the barrel frequently is thrown out before it is empty. This is due to the fact that the faucet usually is driven into the barrel an inch or two above the head. Instead of knocking out the bung and draining the barrel, the faucet is removed and the barrel is returned with that part of the oil left in it which could not be drained through this outlet. In addition, the faucet in the barrel is always liable to accident and if it is knocked out of the barrel, a large amount of oil usually is wasted before the faucet can be replaced. In addition, the faucet frequently is left partly open, resulting also in considerable waste.

Storage Tanks

In several shops core oil storage tanks, built by S. F. Bowser & Co., Fort Wayne, Ind., are being installed. They are provided with a combination suction and force pump which is so arranged that the oil can be discharged in predetermined quantities at the option of the operator. The different quantity measurements, including gallon, half gallon, quart or pint, are regulated by a lever working upon the quantity dial which is in plain view and is easily accessible. The expansion chamber consists of a tube with a hollow ball at the head of the pump and provides for the expansion of the liquid in the cylinder, due to changes in temperature. The pump is provided with an anti-drip nozzle, which cuts off the flow of oil when pumping ceases. The discharge register automatically records the number of gallons pumped, from one to 10 and then repeats. Each pump is equipped with a meter that accurately record, up to 10,000 gallons, the amount of oil drawn. This makes it possible to accurately check the amount of core oil used. Fig. 1 is a view of a battery of oil storage tanks. Each unit is complete and is equipped with a self-measuring pump, discharge register, etc. Fig. 2 is a broken section of the tank showing the pump, gage stick, etc. These tanks are made of galvanized steel, the seams being riveted and soldered both inside and out. Seepage and leakage of the oil cannot occur, as the tanks are absolutely oil tight. Each tank is provided with an 18-inch manhole with a bolted cover, in the center of which is a 2½-inch bar plug. From the opening made by this bar plug a tube is hermetically sealed to the manhole cover, extending downward to within 1 inch of the bottom of the tank. A graduated metal gage stick is inserted in a tube also extending to within 1 inch of the bottom of the tank and is tapped to an air-tight metal screw cap, which is operated from the top of the tank.

Filing the Tank

If oil is spilled, it is returned to the tank through the drip pan, which has a tube extending from its center to within 1 inch of the bottom of the tank. The bottom of the pump, or the lowest point of suction, is raised 1½ inches from the bottom of the tank and it is obvious, therefore, that the three tubes are always sealed in oil. The tank is practically filled from the bottom. When a barrel of oil is emptied into the tank it displaces an equal amount of air which is forced up through the vent to the atmosphere at a point outside of the building. The entire equipment is designed to be air-tight, thereby keeping the oil in the same condition as it was when it was received from the manufacturer. The action of the pump in drawing the oil from the bottom of the tank has a tendency to agitate the contents of the tank and the oil discharged is always of uniform consistency. Hand-power agitators are furnished when desired.

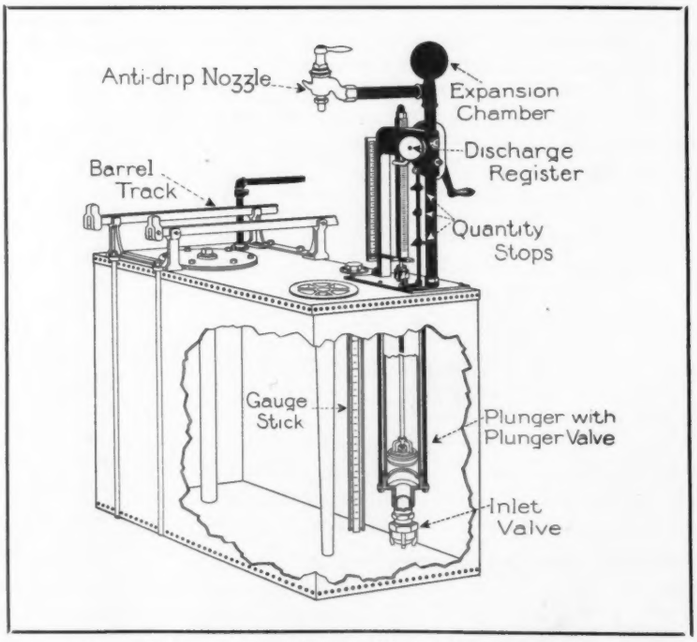

FIG. 2—BROKEN SECTION OF CORE OIL STORAGE TANK

When the tanks are arranged in battery form, a device for handling barrels is employed which consists of a cradle, track, dash and chain hoist. The barrel is placed on the cradle, is raised into position by the chain hoist and then is rolled into place over the

proper tank and the contents are discharged by gravity. Splashing and waste are prevented by the barrel dash. This device also eliminates the use of transfer pumps.

Flooring for Industrial Plants

A composition flooring for industrial plants, whose base consists of asphalt mastic, a product in which a finely graded mineral aggregate is bonded together with asphaltic cement or binder, is manufactured by the H. W. Johns-Manville Co., New York City. The mineral aggregate in the material will pass through a wire screen ranging from 80 to 200 mesh. It is claimed that this flooring provides a surface that is waterproof and also is unaffected by acid, alkali and brine. It can be thoroughly cleaned by the simple process of flushing, after which it dries out immediately; furthermore, it will not generate dust. This flooring can be made in any consistency between extreme hardness and softness and while always dense, it possesses a certain amount of resiliency. The material adds very little to the dead load, as the standard thickness of 1½ inches weighs only 18 pounds per square foot. This material can be laid over any foundation which is firm and stable and may be applied over wood, brick, concrete or tile already in place. This flooring can be used to advantage in industrial plants and gives particularly efficient service where there is considerable trucking.

L. H. Roe, 2848 Alki avenue, Seattle, Wash., has been appointed Pacic Coast representative of the Herman Pneumatic Machine Co., manufacturer of molding machines, Zelienople, Pa.

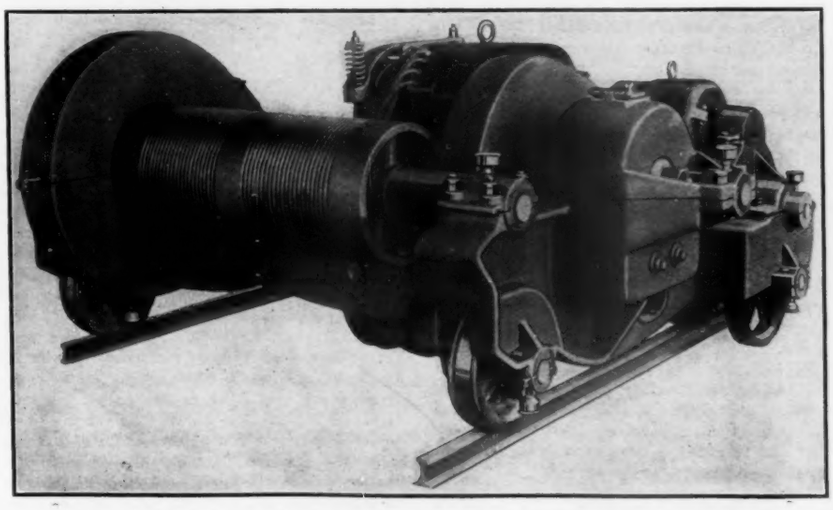

FIG. 1—END VIEW OF INSIDE AND ENCLOSED GEARING TROLLEY

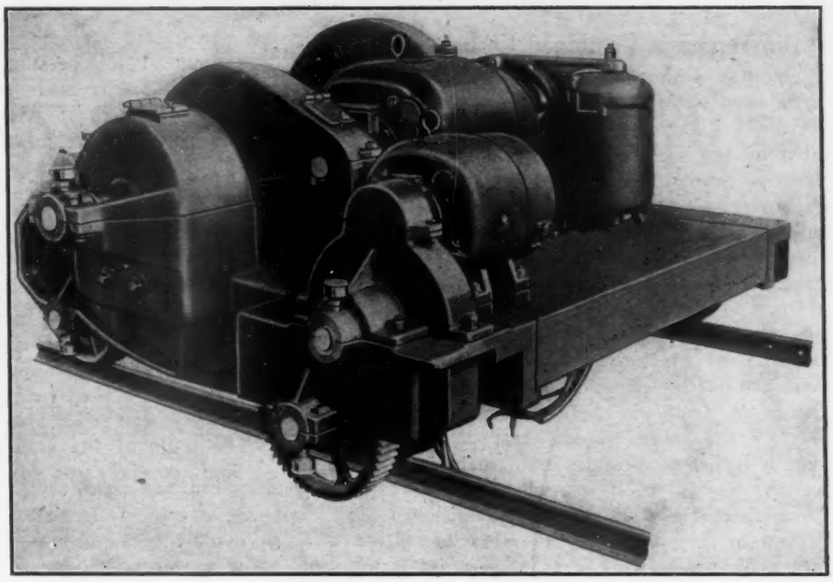

FIG. 2—OPPOSITE END OF TROLLEY FOR ELECTRIC TRAVELING CRANES

Trolley With Enclosed Gearing

A new type of trolley for electric traveling cranes, with inside and enclosed gearing, is now being built by the Whiting Foundry Equipment Co., Harvey, Ill. All gears are inside of the main bearings for their shafts, thereby absolutely preventing the gears from working off the shafts and from falling on to the floor, endangering the lives of the workmen. Two views of the trolley, which has a capacity of 10 tons, are shown in Figs. 1 and 2. The trolley trucks are made of I-beam sections and the bolts for holding on the caps extend through the flanges, permitting a common bolt to be used. The mechanical brake of the hoisting mechanism is contained in a pocket in the truck and necessary adjustments can be made without removing the cover. When used with dynamic braking, the mechanical brake is omitted. The trolley travel gearing is in two reductions from the motor to the trolley axle and all gear cases are cast iron with horizontal machined joints. Liberal openings have been provided in each case for the inspection and lubrication of the gears. The shaft boxes are integral with the truck castings and the caps are matched and are interchangeable for drum and intermediate shafts. All bearings are cast iron with babbitted shells except the axle bearings, which are bronze. The bearings are machined to gages, turned on the outside and are fitted into bored boxes.

The trolley frame consists of two cast iron trucks connected by a cast separator, each end of which rests on a ledge extending from the trolley side, which eliminates shear on connecting bolts. A large platform thus is provided for mounting motors and operating mechanism. This permits the attendant to inspect the equipment with the greatest facility. The electric wires lead directly from the motors to the collector brackets attached to poles supported below the trolley frame. A limit switch operated by the block itself is furnished in connection with the hoisting mechanism.

The Jonathan Bartley Crucible Co., Trenton, N. J., has added a new kiln and sufficient new machinery has been installed which will double the capacity of the plant.

To remove enamel from almost any metal, heat the article to a dull red and cover its surface with powdered potassium cyanide. After cooling, the enamel can be dissolved in water.

Differences in Combined Carbon

Question:—Although casting conditions seem to be the same, nevertheless we find a slight variation in the quantity of combined carbon in our gray iron castings poured from the same heat.

Answer:—It is probable that there might be a slight difference in temperature of the iron at the moment of pouring, and this would result in the difference in the combined carbon which you mention. The balance between the tendency to graphitize and to remain combined is so delicate that any slight change in conditions might turn it one way or the other. Pieces cast at a slightly higher temperature or in slightly warmer molds cool somewhat more slowly, and this would induce a greater degree of graphitizing. It might be difficult to trace this change, but it might be advisable to melt your iron hotter at the time when you find your combined carbon is highest. This would probably decrease the proportion of combined carbon.

Cerium Retards Corrosion of Aluminum

A patent has been issued in Germany to Dr. Wilhelm Borchers and Otto Barth for an alloy of cerium and aluminum. This alloy, it is claimed, is less liable to corrosion than aluminum not so alloyed. To alloy cerium with the aluminum, the latter is heated to about 1,000 degrees Cent., which is several hundred degrees above its melting point and an addition is made of fluoride of a cerite metal, either by itself or in admixture with other salts. Approximately 1.5 per cent of the cerium metal will alloy with the aluminum, although it has been found in practice that 0.05 per cent of cerium is sufficient to exert a beneficial effect on the properties of aluminum. The explanation of the effect of the cerium seems to be found in the diminution of the silicon content. Silicon dissolves in molten aluminum, but separates on cooling much in the same way that graphite separates from cast iron.

Record Furnace Run

Open-hearth furnace No. 5 in the steel casting plant of the Pressed Steel Car Co., McKees Rocks, Pa., has made a remarkable record. Since it was first placed in operation on Sept. 27, 1909, it has produced steel continuously until Nov. 2, 1912, with the exception of an idleness of three days to change checkers. The furnace was shut down on July 2, 1911, after 992 heats had been made and was started again three days later. It continued in operation until Nov. 2 last year, having made a total of 1,792 heats, averaging 15 tons per heat. Since the repairs were made in November, the furnace has made 187 heats with the same roof that was used during the former run.

Kelly Warehouse Re-stocked

The Hamilton, Ohio, warehouse of T. P. Kelly & Co., New York City, manufacturer of foundry facings and supplies, was inundated by the recent high water and the entire stock was a total loss. The mills of the company are being operated night and day to replace this stock and a complete line of supplies will be delivered to the Hamilton warehouse by the time that the foundries of southern Ohio are ready to resume operations.

The thirteenth annual summer school of the College of Engineering of the University of Wisconsin, Madison, Wis., will open June 23. Courses of instruction and laboratory practice will include electrical, hydraulic, steam and gas engineering, mechanical drawing, applied mechanics, testing of materials, machine design, shop work and surveying, in addition to which, subjects may be taken in the College of Letters and Science.

NEW TRADE PUBLICATIONS

THERMOMETERS.—The Industrial Instrument Co., Foxboro, Mass., has issued a handsomely-illustrated, 40-page bulletin devoted to its thermographs, dial type thermometers, and recording hygrometers.

AIR COMPRESSORS. — A 20-page illustrated bulletin, recently issued by the Ingersoll-Rand Co., New York City, is devoted to duplex, power-driven air compressors. Some of the advantages claimed for this type of air compressor are balanced construction, and the ease with which the air cylinders can be compounded without any increase in the number of working parts. These compressors are particularly adapted for use in foundries.

STORAGE BATTERY TRUCKS.—The Automatic Transportation Co., Buffalo, has issued a 28-page illustrated booklet devoted to its storage battery freight, baggage, and industrial trucks. It is claimed that these trucks, when loaded, will negotiate grades of from 15 to 25 per cent, and will cover a distance in one-quarter the time and will handle about six times as much freight as hand-operated trucks.

DUST COLLECTING SYSTEMS.—In a 16-page catalog the Cleveland Blow Pipe & Mfg. Co., Cleveland, illustrates and describes its various appliances used in dust collecting systems for emery, buffing and polishing wheels, grinders, emery belts and other dust producing machinery. This equipment includes adjustable hoods of various types, vacuum hoods, dust separators, exhaust fans, blast and exhaust blow piping, etc. A partial list of users also is noted.

SAND-BLAST MACHINES. — A 16-page catalog, well-illustrated, has been issued by the Hoevel Sandblast Machine Co., 50 Church street, New York City. This machine is entirely self-contained and is built in numerous styles, including revolving barrel, rotary table, sprocket table and rotary floor types. Sandblast cleaning chambers also are shown, as well as numerous large installations in various foundries. Suggestions also are included for obtaining the greatest economies in sandblast operations.

CRUCIBLES.—A handsomely-illustrated, 24-page catalog, devoted to crucibles and other graphite products, has been issued by the Ross-Tacony Crucible Co., Tacony, Philadelphia. Numerous views are included, showing the company's plant, extensive storeroom, shipping department, yard, storage sheds, etc. A wide assortment of brass, steel and special crucibles is illustrated, together with stoppers, nozzles, sleeves, retorts, stirrers, skimmers, phosphorizers, etc. Considerable interesting data also are published in this catalog regarding the treatment of crucibles, the care that should be required in annealing and the operation of furnaces to obtain the greatest efficiency.

CAR AND LOCOMOTIVE BRASSES. — An 88-page catalog describing car and locomotive brasses, ingot metals, babbitt metals and castings for the lumber trade, has been issued by the Ajax Metal Co., Philadelphia. Fifty-six pages contain illustrations and diagrams of the various types and designs of bearings manufactured by this company. These pages are printed on one side only and it is intended that the dimensions should be written on the diagrams and the pages torn out and sent in with the order. The publication is compiled so as to be of permanent value to the man in the field or camp. It contains valuable data and information on logs, lumber, track laying, rails, weights of cars and materials, grades, etc.

AIR COMPRESSORS.—The Union Steam Pump Co., Battle Creek, Mich., has issued a 52-page bulletin describing its duplex steam and belt-driven air compressors. It is claimed that for pressures of 100 pounds per square inch or over, it is desirable to install a two-stage compressor for the following reasons: First, the machine will run more economically; second, the air is delivered cooler and will leave more of its moisture in the air-receiver; third, the temperature of the air being lower, it is easier to keep the cylinder lubricated; fourth, the lower temperature prevents explosions which sometimes occur in air tanks and pipes where single stage compressors are used, and where the oil becomes carbonized from the high temperature. The duplex compressors manufactured by this company are of the center-crank design with heavily-ribbed sub-bases, and the belt-driven machines are designed to take a generous size and width of pulley so as to reduce the belt tension to a minimum.

THE MEN IN THE FOUNDRY TRADE

Where They Are and What They Are Doing

PETER J. LEWIS has been appointed assistant superintendent of the Lackawanna railroad foundry, Scranton, Pa.

C. W. WESTON has been appointed manager of the Progressive Stove & Furnace Co., Colorado Springs, Colo.

WILLIAM HUFF has been appointed foundry foreman of the Wabash Foundry & Machine Co., Wabash, Ind.

F. M. CLARK has been appointed foundry foreman of the Ruthnings Works, Ltd., Brisbane, Australia.

URBAN W. FRINK is now affiliated with the Black Products Co., Chicago, and will represent this company in the New England territory.

John Harsch, general foreman of the architectural iron and brass foundries operated by the W. S. Tyler Co., Cleveland, has resigned.

C. G. HOWE, formerly one of the sales representatives of the H. E. Mills Mfg. Co., Syracuse, N. Y., is now affiliated with the Peterson-National Co., manufacturer of core oils, Buffalo.

JOHN Y. LYLE, foundry foreman of Burns & Co., Ltd., Howrah, India, has returned to his post after a six-months' vacation in Rutherglen, Lanarkshire, Scotland.

R. P. CUNNINGHAM, who was employed in the capacity of foundry foreman by the Deane Steam Pump Co., Holyoke, Mass., is now affiliated with the Humphrey Machine Co., Keene, N. H.

EDWIN F. CONE, for a number of years metallurgist at the Chester, Pa., plant of the American Steel Foundries, has joined the editorial staff of *The Iron Age*.

W. O. WAYMAN, formerly general superintendent of the Illinois Malleable Iron Co., Chicago, has retired and will spend the next few years in travel abroad.

Paul Vanderlist, formerly in charge of the foundry operated by the Buss Machinery Works, Holland, Mich., is now associated with the Holland Furnace Co. of that city.

HENRY G. MACCORMAC, formerly connected with the Waterloo Register Co., Waterloo, Ia., is now superintendent of the James Stewart Foundry Co. of the same place.

T. G. BELL has been appointed general foreman of the Termaat & Monahan Foundry, Oshkosh, Wis. He formerly was employed by the Sailor-Whitmore Co., Menasha, Wis.

B. W. PHARIS, formerly superintendent of the Canada Foundry Co., Toronto, Ont., has been appointed foundry superintendent of the Erie Engine Works, Erie, Pa.

F. R. ELBERT has resigned as superintendent of Bowes, Jamieson, Ltd., iron founders, Hamilton, Ont., and has accepted a position with the Ohio Foundry & Mfg. Co., Steubenville, O.

G. E. MORELAND has resigned as foreman plater of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and has accepted a similar position with the California Industrial Co., Los Angeles, Cal.

HENRY M. REED, formerly manager of the Louisville plant of the Standard Sanitary Mfg. Co., Pittsburgh, has been appointed assistant general manager of this company with headquarters at Pittsburgh.

CARL F. BATTENFELD, who was affiliated for many years with the Berkshire Mfg. Co., molding machine manufacturer, Cleveland, in the capacity of sales representative, resigned May 1 to accept a position with the United States Molding Machine Co., Cleveland.

PAUL RAMP, formerly superintendent of the General Electric Co.'s foundry, Schenectady, N. Y., has accepted a similar position with the Quigley Furnace & Foundry Co., located at Brightwood, near Springfield, Mass.

DAVID WILSON, president of the New York Foundrymen's Association, has severed his connection with the M. W. Kellogg Foundry, Jersey City, to accept a position as superintendent of the Stamford Foundry, Stamford, Conn.

E. B. ROUSE, formerly foundry superintendent of the casting shop operated by the Canadian Fairbanks Co., Sherbrooke, Que., has been appointed superintendent of the Lawrence Foundry Co., Montreal.

HARRY FISHER, who was employed for many years by the Bass Foundry & Machine Co., Fort Wayne, Ind., has been appointed superintendent of the Treadwell Engineering Co.'s foundry, Easton, Pa.

GEORGE HILLS, for several years manager of the welding department of the Garwood Electric Co., and the C. & C. Electric & Mfg. Co., Garwood, N. J., has resigned to accept a position with the Electric Welding Material Co., 149 Broadway, New York City.

A. W. MOYER, formerly associated with the Rockwell Furnace Co., New York City, is now affiliated with the Quigley Furnace & Foundry Co., Springfield, Mass. Mr. Moyer has charge of the accurate temperature furnace department.

ANDREW THOMPSON, general manager of the Titanium Alloy Mfg. Co., Niagara Falls, N. Y., has assumed charge of the sale of the company's products. A. C. Hawley will represent the company in the Pittsburgh district with office in the Oliver building.

G. M. THRASHER has resigned as chief chemist of the foundry of Stanley G. Flagg & Co., Pottstown, Pa., and has been appointed superintendent of cupolas of the Standard Cast Iron Pipe & Foundry Co., ,Bristol, Pa. Mr. Thrasher assumed his new duties on May 1.

Standard Babbitt Mixtures

A meeting of the sub-committee of the American Society for Testing Materials, which is evolving the standard specifications for babbitt metals, recently was held at Pittsburgh. An effort is being made to reduce the large number of mixtures now made to a few standards which, it is believed, will be sufficient to meet all requirements. From data presented to the committee, it is believed that five standards can be evolved which will cover satisfactorily the range of babbitt metals for all requirements. This series includes five grades as follows:

1.—Tin, 83.33 per cent; antimony, 8.33 per cent, and copper, 8.33 per cent.

2. Tin, 89 per cent; antimony, 7 per cent, and copper, 4 per cent.

3. Tin, 50 per cent; antimony, 15 per cent; copper, 2 per cent, and lead, 33 per cent.

4. Tin, 5 per cent; antimony, 15 per cent, and lead, 80 per cent.

5. Antimony, 10 per cent, and lead, 90 per cent.

These mixtures are arranged in relation to their hardness, No. 1 being the hardest and No. 5 the softest of the series. Additional tests are to be made before the report is submitted at the next meeting of the American Society for Testing Materials.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The Ohio Sash Weight & Foundry Co. has been incorporated with a capital of $10,000. Stoves, furnaces, etc., will be manufactured.

The Groton Iron & Brass Foundry, Groton, Conn., which ceased operation about six weeks ago, has been dismantled.

The Midland Lumber Co., Minneapolis, Minn., has purchaesd the foundry of the F. G. & C. A. Stanley Co., at Chippewa Falls, Wis.

The foundry of the Farmers' Machine Co., Watrous, Sask., was placed in operation early in April.

The Brennan-Smythe Steel Castings Co., 2284 Scranton road, Cleveland, will place its side-blow converter in operation within a few weeks; in addition, this company has four crucible furnaces of 10 pots each.

The City Iron Works, Camden, Pa., has been incorporated by Albert Gardner, W. S. Darnell, and H. S. Darnell. The concern is capitalized at $10,000, and will operate a foundry and machine shop.

The Hawkins-Barnett Co., Trinidad, Colo., sold its plant to the Miller Foundry, Machine & Mfg. Co., which has been incorporated, with $50,000 capital, by James B. Miller, Geo. B. Mullare, and E. J. McMahon.

The Shelby Steel Tube Department of the National Tube Co., Pittsburgh, has added a gray iron foundry to its Ellwood City, Pa., plant. This shop will make a specialty of pipe balls.

The American District Steam Co., which operates a large wood-working plant, foundry, etc., at North Tonawanda, N. Y., has transferred its machine shop and general offices to that city from Lockport, N. Y.

The Stedman Foundry & Machine Co., Aurora, Ind., has been purchased by Chester A. Peebles, George H. Martin, Perin Langdon, Jr., and S. B. Sutphin. of Cincinnati, and will be operated under their management in the future.

The Strong Steel Foundry Co., Buffalo, recently moved into its new plant. The buildings are of modern construction, with reinforced concrete walls and cement tile roofs. They consist of a foundry, 125 x 225 feet; pattern shop and storage, 105 x 180 feet, and an office building, 40 x 50 feet.

The firm name of the Means Engineering & Foundry Co., Toronto, O., has been changed to the Henderson Foundry & Machine Co. E. L. Henderson is president; Thomas Price, vice president; R. W. Henderson, treasurer, and Charles E. Wells, secretary and general manager.

The Dominion Steel Castings Co. and the Hamilton Malleable Castings Co., both of Hamilton, Ont., have been combined under the name of the Dominion Steel Foundry Co., capitalized at $2,000,000. C. W. Sherman, formerly general manager of Pratt & Letchworth, Buffalo, is president.

The Motor Foundry Co., Detroit, will increase its capital stock from $35,000 to $100,000 to provide for extensions to its plant. The capacity of the shop, which produces gray iron motor castings exclusively, will be doubled. The officers are J. H. James, president; E. A. Nelson, vice president, and L. H. Green, secretary.

New Construction

The American Foundry Co., Rockford, Ill., is erecting a foundry building, 65 x 85 feet.

The Lavelle Foundry Co., Anderson, Ind., is preparing plans for an addition to its plant.

The Jordan L. Mott Iron Co. is planning to build a three-story addition to its foundry.

The Hamilton Foundry & Machine Co., Hamilton, O., is erecting a foundry, 60 x 455 feet.

The American Malleable Castings Co., Lancaster, N. Y., is erecting an addition, 50 x 75 feet.

The Kansas City Hay Press Co., Kansas City, Mo., is erecting a foundry, 120 x 152 feet.

Arnett & Elledg, gray iron founders, Gainsville, Tex., are erecting a foundry, 30 x 40 feet.

The Western Iron & Foundry Co., Wichita, Kan., is erecting an addition to its foundry.

The Springfield Foundry Co., Indian Orchard, Mass., will erect a carpenter shop and pattern storage warehouse.

The American Skein & Foundry Co., Racine, Wis., is building a 120-foot addition to its foundry.

The Hamilton Foundry & Machine Co., Hamilton, O., has placed a contract for a one-story brick addition, 70 x 450 feet.

The Co-operative Foundry Co., Rochester, N. Y., is building a four-story office and warehouse, 76 x 193 feet.

The American Foundry Co., Lexington, Ky., is contemplating the erection of an addition to its plant, 66 x 80 feet.

The F. P. Smith Wire & Iron Works, with general offices at 56 West Lake street, Chicago, is erecting a foundry, 80 x 140 feet.

The Norman-Lewis Foundry Co., Rusk, Tex., is building a gray iron foundry, the principal product of which is to be sash weights.

The Manufacturers' Foundry Co., Waterbury, Conn., will erect two buildings, one 35 x 65 feet and the other, 35 x 50 feet, both two stories.

The North Chicago Foundry Co., North Chicago, will erect an extension to its plant, 64 x 210 feet, and a fireproof pattern vault, 30 x 50 feet.

The Erie Malleable Iron Co., Erie, Pa., is erecting a new foundry which will contain three furnaces and will considerably increase the output of this plant.

The Bayview Foundry Co., Sandusky, O., is contemplating the extension of its manufacturing facilities. The capital stock has been increased from $75,000 to $100,000.

The Sohn & Rentchler Co., Hamilton, O., will erect a new foundry to take the place of the plant that was destroyed by the flood. Considerable new equipment will be required.

The Harvey Bed Co., Racine, Wis., is erecting a foundry, 50 x 190 feet. E. J. Harvey is vice president and superintendent of the company.

The Gurney Foundry Co., Toronto, Can., is erecting a two-story cupola building and a core shop. The buildings are to be constructed of brick and steel and are to cost $80,000.

The E. M. Burr Foundry Co., Champaign, Ill., is erecting a foundry, 120 x 132 feet, and a structural shop, 100 x 136 feet. The buildings are of steel construction and electric traveling cranes are being installed.

A foundry is being erected at Paris, Ont., by A. A. Bradley. The equipment of the casting plant of the International Harvester Co. at that place was purchased and is being installed.

The English & Mersick Co., manufacturers of automobile hardware, New Haven, Conn., is erecting a brick building, 60 x 105 feet, which will be equipped as a brass foundry. The metal will be melted in nine oil-burning furnaces.

The Independent Harvester Co., Plano, Ill., will build a foundry, 208 x 136 feet, and a three story, reinforced concrete, cleaning room, 136 x 80 feet. These are the first buildings of a $3,000,000 plant which this company proposes to build within the next three years.

The Acme Foundry Co., Cleveland, will erect a two-story brick pattern storage building and core room. Wilber J. Watson & Co., Citizens building, Cleveland, are the architects, and Henry Slatmyer is the general contractor.

The Swedish Crucible Steel Co., Detroit, has completed several additions to its foundry and is now planning to further increase its facilities. This company is also making preparations to erect a large steel and iron foundry at Windsor, Ont. A site of four acres was purchased recently.

The Standard Foundry & Mfg. Co., Alma, Mich., contemplates the installation of individual electric motors to operate its blower, drill presses, shapers, and grinding wheels. An electric elevator also will be installed to deliver pig iron and coke to the charging floor. Central station power is used.

The Illinois Malleable Iron Co., Chicago, is erecting an addition to its plant, 170 x 180 feet. A central power plant also is being built. Four melting furnaces are equipped with waste heat boilers of 600-horsepower capacity each, and the steam produced will be used in the new power plant to generate electricity to supply the entire works.

The Enterprise Foundry Co., Auburn, N. Y., is rebuilding its plant which was destroyed by fire several months ago. The new shop will be about one-third larger than the former foundry and will have room for 60 molders. A contract for a new core room has also been let. A foundry, 66 x 136 feet, is under construction for the John T. Young Boiler Co., Norwich, Conn.

The Latrobe Steel Co., Latrobe, Pa., has been organized with a capital of $300,000 to engage in the manufacture of manganese steel castings. The metal will be refined in a 5-ton electric furnace, the current being supplied by the West Penn Traction Co. The officers of the company follow: M. Saxman, president; Charles W. Guttzeit, vice president; F. B. McFeely, secretary, and I. B. Shallenberger, treasurer.